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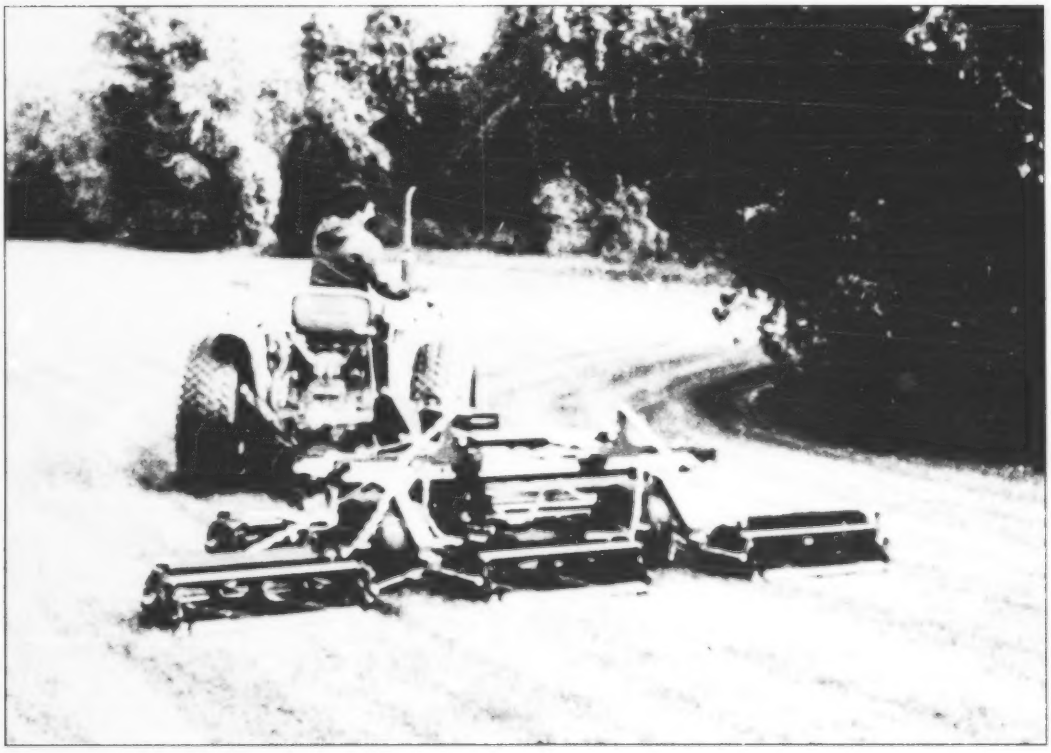
RECOMMENDATIONS FOR TURFGRASS MANAGEMENT



Ontario
Ministry of Agriculture and Food

To the best of the collective knowledge of the members of the Ontario Crop Protection Committee, all pesticides listed in this publication were federally registered, reviewed by the Ontario Pesticides Advisory Committee and classified by the Ministry of the Environment as of November 7, 1990.

The information presented on the pesticide container label regarding application rates and methods of application is the final authority and where conflicts occur between this publication and the container label, the latter applies.

PAY CLOSE ATTENTION TO ALL INSTRUCTIONS AND WARNINGS PRINTED ON THE PESTICIDE LABEL.

The Ministry of Agriculture and Food, or the Ontario Crop Protection Committee by printing this publication does not offer any warranty or guarantee and does not assume any liability for any crop loss, animal loss, health, safety or environmental hazard caused by the use of a pesticide mentioned in this publication.

POLICY STATEMENT

In this publication, most recommendations list several pesticides that are effective for each insect or disease discussed. Where possible, the less hazardous materials and those that growers have used satisfactorily for a number of years are listed first. These are followed by the more toxic pesticides and/or newer ones with which we have less experience. It must be emphasized that, in some cases, the most effective pesticides are highly toxic.

Weather and other factors influence the effectiveness of pesticides and the likelihood of plant injury by control chemicals. Consult the package label and other information regarding compatibility with other materials, the effect of high or low temperatures, poor drying conditions, etc. Wettable or soluble powders (WP or SP) generally are less likely to cause plant injury than liquid concentrates (EC, SC, and F).

A number of brand names of pesticides are given in the calendars as a convenience to the grower and are neither an endorsement of the product nor a suggestion that similar products are not effective.

The pesticide recommendations are reviewed annually by the Ontario Crop Protection Committee. **OLD EDITIONS SHOULD BE DISCARDED.**

For additional information or clarification of recommendations, contact Ontario Ministry of Agriculture and Food personnel listed on page 2.

FEDERAL REGISTRATION AND PROVINCIAL CLASSIFICATION

Ontario's Pesticides Act and Regulation 751, administered by the Ministry of the Environment, prohibits the sale and use of pesticide products unless they are registered under the federal Pest Control Products Act and classified under the provincial Pesticides Act by being placed in one of six schedules of the Ontario regulation.

FEDERAL REGISTRATION

There are three categories:

1. **Full Registration**
   Implies that all federal departments involved in the registration process agreed that the data package was acceptable at time of registration.
2. **Temporary Registration**
   Indicates that there is a need for additional scientific or technical information to acquire a full registration. Temporary registrations expire on the 31st of December each year and the products must be re-registered if they are to be available for use in the following year.
3. **Temporary Registration (Restricted Class)**
   Indicates that there is an urgent need for the pesticide but that studies on the safety of the product are incomplete. Such registrations expire on the 31st of December each year and the products must be re-registered if they are to be available for use the following year.

PROVINCIAL CLASSIFICATION

Pesticide products are classified into six schedules in Regulation 751 on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient or its metabolites, concentration and usage. This classification system provides the basis for regulating the distribution, availability and use of pesticide products in Ontario.

The pesticide products presently carrying temporary registration may or may not be classified and available in Ontario in 1989.

For updated information of the regulatory status of these or other pesticides contact the Pesticide Section, Hazardous Contaminants Coordination Branch, Ministry of the Environment, Toronto. Telephone (416) 323-5095.

The pesticide recommendations in this publication are for commercial plantings in Ontario. Home gardeners should use products and methods recommended in Ontario Ministry of Agriculture and Food Publication 64, *1990-1991 Insect and Disease Control in the Home Garden.*

ACKNOWLEDGEMENTS

The recommendations contained in this publication have been prepared in consultation with:

— Ontario Crop Protection Committee
— Ontario Ornamental Research Committee
— Ontario Soil Management Research Committee

and personnel of:

— Plant Industry Branch, Ontario Ministry of Agriculture and Food
— Ontario Agriculture College, University of Guelph
— Agriculture Canada
— Ontario Ministry of the Environment
— Royal Botanical Gardens
— Ontario Ministry of Natural Resources
— Ontario Ministry of Labour
— Health and Welfare Canada
— Horticultural Research Institute of Ontario

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ONTARIO MINISTRY OF AGRICULTURE AND FOOD

HORTICULTURAL CROP ADVISORS

Area Served or Specialty	Name	Address	Phone No.
N.W. Ontario		Ontario Government Building 435 James St. S., Thunder Bay, P7E 6E3	807-475-1631
Eastern Ontario	Kevin Schooley	College of Agricultural Technology Kemptville, K0G 1J0	613-258-8359
Prince Edward, Hastings, Lennox, Addington, Frontenac	Allan Moynes	P.O. Box 470, Picton, K0K 2T0	613-476-3224
Northumberland, Peterborough	Dave Ridgway	P.O. Box 340, Trenton, K8V 5R5	613-392-3527
Durham, Victoria, York	Tom Clarke	234 King Street East Bowmanville, L1C 1P5	416-623-3348
North York (Bradford Marsh Area)	Mary Ruth McDonald	Muck Research Station R.R. #1, Kettleby, L0G 1J0	416-775-3783
Simcoe, Dufferin, Grey	Ken Wilson	P.O. Box 69, Clarksburg, N0H 1J0	519-599-2042
Halton, Wellington, North Wentworth	Joe Uyenaka	R.R. #1, Ancaster, L3Y 3K9	416-527-2995
Niagara Peninsula	Burke McNeill	Vineland Station, L0R 2E0	416-562-4142
Haldimand-Norfolk, Brant	Jody Bodnar Steve Rowe	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120
Oxford, Elgin, Perth, Waterloo	Keith Priest	P.O. Box 666, Woodstock, N4S 7Z5	519-537-6621
Lambton, Middlesex, Huron	John Gardner	50 King St., London, N6A 2P2	519-434-6811
Essex, Kent	Ed Tomecek Anne Verhallen	College of Agricultural Technology Ridgetown, N0P 2C0	519-674-5456
Essex, Kent	Clem Fisher Leslie Huffman	Research Station, Harrow, N0R 1G0	519-738-2251
Marketing	Bob Cobbledick	Vineland Station, L0R 2E0	416-562-4142
Potatoes	Sam Squire	P.O. Box 370, Alliston, L0M 1A0	705-435-5521
Greenhouse Crops	Wayne Brown	Vineland Station, L0R 2E0	416-562-4141
Greenhouse Flowers	John Hughes	Dept. of Horticultural Science Univ. of Guelph, Guelph, N1G 2W1	519-824-4120 Ext. 8910
Nursery	Chris Kessel	Unit 9, 35 Van Kirk Drive Brampton, L7A 1A5	416-451-5474
Turfgrass	Annette Anderson	Dept. of Horticultural Science Univ. of Guelph, Guelph, N1G 2W1	519-824-4120 Ext. 2597
Maple Syrup	John Butler	P.O. Box 340, Elmvale, L0L 1P0	705-322-2231
Grape & Wine Specialist	Joseph Zimmerman	Vineland Station, L0R 2E0	416-562-4147

PEST MANAGEMENT ADVISORS

Durham, Victoria, Peel (apples, pathology, fresh vegetables)	Andrea Clarke	234 King Street East Bowmanville, L1C 1P5	416-623-3348
Northumberland, Peterborough, Prince Edward (apples, processing vegetables)	Bernt Solymar	P.O. Box 340 Trenton, K8V 5R5	613-392-3527
North York (Bradford Marsh Area) (muck vegetable crops) (potatoes)	Jim Chaput Eugenia Banks	Muck Research Station R.R. #1, Kettleby, L0G 1J0	416-775-4261
Niagara Peninsula (apples, grapes) (peaches, tender and small fruit) (greenhouse floriculture)	Kevin Ker Gerald Walker Graeme Murphy	Vineland Station, N0R 2E0	416-562-4142
Haldimand-Norfolk, Brant (apples, pesticide alternatives) (cole crops)	Pam Fisher Janice Schooley	P.O. Box 587 Simcoe, N3Y 4N5	519-426-7120
Lambton, Middlesex, Huron (corn borer, cut worm, apples) (muck vegetables, rutabagas) (field corn, cereals)	Richard Parry Tom Hartman	50 King Street London, N6A 2P2 Centralia College of Agricultural Technology Huron Park, N0M 1Y0	519-434-6811 519-228-6691
Essex, Kent (fruit trees) (greenhouse vegetables) (tomatoes, processing vegetables)	Todd Leuty Gillian Ferguson Janice Elmhirst	Research Station Harrow, N0R 1G0 College of Ag. Technology Ridgetown, N0P 2C0	519-738-2251 519-674-5456
Georgian Bay (apples, strawberries, asparagus)	Alison Watson	P.O. Box 69, Clarksburg, N0H 1J0	519-599-2042
Provincial Plant Pathologist	Craig Hunter	P.O. Box 587, Simcoe, N3Y 4N5	519-426-7120

ONTARIO MINISTRY OF THE ENVIRONMENT

PESTICIDES CONTROL OFFICES

County	District	Telephone
Bruce, Grey, Huron, Perth	B.T. Lobb Ont. Min. of Agr. & Food Bldg. 20 King St., Box 688 Clinton, Ontario N0M 1L0	519-482-3428
Essex, Kent, Lambton	H.E. Collins P.O. Box 726, 435 Grand Ave. W. Chatham, Ontario N7M 5L1	519-354-2150
Elgin, Middlesex, Oxford	D.C. Morrow/W. Lampman 985 Adelaide St. S. London, Ontario N6E 1V3	519-661-2200
Haldimand, Norfolk, Niagara, Hamilton, Wentworth, Dufferin, Wellington, Waterloo, Brant	P. McCubbin/R. Miller Ontario Government Building 119 King St. W. Hamilton, Ontario L8N 3Z9	416-521-7640
Halton, Peel, York, Durham, Toronto, Simcoe, Muskoka	A.G. Carpentier/H. Ploeg/ C. Zubovits 7 Overlea Blvd., 4th floor Toronto, Ontario M4H 1A8	416-424-3000 416-467-3029 416-467-3025
Peterborough, Victoria, Haliburton, Northumberland	A.G. Carpentier 139 George St. N. Peterborough, Ontario K9J 3G6	705-743-2972
Frontenac, Hastings, Lennox & Addington, Prince Edward, Leeds & Grenville	D.A. Raddon/M. Ferguson 133 Dalton Ave., Box 820 Kingston, Ontario K7L 4X6	613-549-4000
Prescott & Russell, Renfrew, Stormont, Dundas & Glengarry, Ottawa-Carleton, Lanark	R.P. Cameron 2435 Holly Lane Ottawa, Ontario K1V 7P2	613-521-3450
Manitoulin, Nipissing, Parry Sound, Sudbury, Cochrane, Timiskaming, Algoma	T. Spires/J. Negusanti/ K. McDonald 199 Larch Street Sudbury, Ontario P3E 5P9	705-675-4501
Kenora, Rainy River, Thunder Bay	G.R. Gammond Ontario Government Building 435 James St. S. Thunder Bay, "F", Ontario P7C 5G6	807-475-1215
Head Office	Pesticides Section 135 St. Clair Ave. W. Suite 100 Toronto, Ontario M4V 1P5	416-323-5095
Pesticide Licencing & Examination Section	Approvals Branch 3rd Floor, 250 Davisville Ave. Toronto, Ontario M4S 1H2	416-440-3713

GENERAL INFORMATION ON PESTICIDE USAGE

READ THIS ENTIRE SECTION BEFORE USING ANY PESTICIDES

PRECAUTIONS WITH ALL PESTICIDES

General Precautions

1. Always read the label before opening pesticide containers, and follow all precautions and directions. Before starting keep a record of the common names of all pesticides handled and especially those listed as hazardous in this publication. This list should be known by members of your family in the event of an accident.
2. Use an anti-backflow device, to prevent back siphoning, when drawing water from wells, ponds, streams and other sources of water. Mix the pesticide at least 50 m from the water. Triple or pressure rinse the empty container and add rinse water to tank. Only mix enough solution to do the spray job. After loading and mixing wash down gloves and boots with clean water before removing.
3. Never smoke, chew tobacco or eat while handling or applying pesticides. Do not carry tobacco or food items in clothing worn while spraying. Change clothing and wash before eating.
4. When handling and mixing concentrates, rinsing empty containers or repairing leaks, a full set of protective clothing should be worn including waterproof cap, coveralls, impervious gloves and boots, and eye protectors. If highly or extremely toxic pesticides are being used, a respirator should be worn. If very dusty formulations are being handled, a dust mask should be used. If volatiles or gases are being handled, a respirator must be worn. If these gases are highly dangerous or in an enclosed space a self-contained breathing apparatus may be needed.
5. During application, tractor cabs with charcoal filters give adequate protection against exposure. Impervious gloves, boots, coveralls and caps should be worn when tending to stoppages. When using airblast and mist blowers and tractors without cabs, waterproof suits including caps and impervious gloves and boots should be worn. When applying fumigants in the field, a respirator should be available for problems with equipment or if the fumigant is not adequately sealed in the soil and escapes.
6. When the spray operation is complete, take a bath or shower to remove pesticide deposits on the skin. Avoid handling anything in the home before bathing.
7. Well, pond and surface water may be contaminated by pesticides. Every effort should be made to keep this from happening. For more details see OMAF Factsheets 88-083 (Agdex 607) *Management of Pesticides on the Farm*, 86-077 (Agdex 607) *Pesticide Contamination of Farm Water Supplies* and 87-044 (Agdex 607) *Guide to Handling and Applying Herbicide to Protect Water Supplies and Reduce Personal Exposure.*

   It is an offense to contaminate surface waters with pesticides. To prevent this from occurring:

   - Keep pesticide concentrates above flood plain in a locked storage.
   - After emptying containers triple or pressure rinse, crush and dispose of at an appropriate landfill site.
   - Mix concentrate and water at least 50 m away from any water supply.
   - Use appropriate buffer zones and berms to avoid surface water contamination of wells, ponds and streams.
   - If possible, do not use drinking water sources to fill spray equipment.
   - Do not spray within 10 m of shallow wells or 5–10 m of other water supplies under ideal conditions and increase these distances if there is any air movement. Stop spraying when wind velocity reaches 10 km/hr.
   - There are government programs to protect your water supplies and assist in building pesticide storage facilities.

IF ACCIDENTS OCCUR

1. If an accident occurs, remove contaminated clothing including underclothes immediately, and wash contaminated skin thoroughly with soap and water. Wash gloves, boots, and respirator before and after removal. Presoak clothes and double launder immediately. If the spill was serious, place the clothes in a plastic bag and dispose in a safe manner.
2. If clothing becomes wet with a pesticide during spraying, remove it immediately, wash and put on freshly laundered clothes.
3. If symptoms of illness occur during or shortly after handling or applying a pesticide, get the patient to a hospital immediately. Take the list of common-name chemicals with you to the hospital (see Emergency Procedures for Pesticide Poisoning on the back cover).
4. Clean up any pesticide spills immediately. In the case of minor spills, use dry soil or other absorbent material to remove excess liquid and sweep up powders and granulars. Contaminated soil and sweepings should be spread over a larger area of bare soil to facilitate rapid degradation. Make sure you are adequately protected when cleaning up the spill.

   In the case of a major pesticide "spill" the Ministry of the Environment, Spills Action Centre, 5th Floor, 7 Overlea Blvd., Toronto, Ontario, M4H 1A8, telephone (416) 965-9619 or 1-800-268-6060 must be notified.
5. If a well becomes contaminated, follow clean-up instructions in OMAF Factsheet, *Pesticide Contamination of Farm Water Supplies*, Agdex 607.

EMERGENCY PROCEDURES FOR PESTICIDE POISONING, FIRST-AID INFORMATION
(See Back Cover)

RELATIVE TOXICITY TO APPLICATOR

Definitions

Lethal Dose 50% (LD_{50}): The dose which when administered will kill 50% of the test animals within a stated period of time (i.e., 1-6 days).

Acute Toxicity: Immediate adverse effects from a single or short period exposure to a substance, either by the oral, dermal or inhalation route.

Chronic Toxicity: Adverse effects resulting from repeated exposure to a substance over an extended period of time.

High Acute Toxicity
These pesticides are extremely dangerous if handled carelessly. The acute oral LD_{50} is less than 50 mg/kg of body weight and the acute dermal LD_{50} less than 200 mg/kg body weight. These pesticides can be fatal by swallowing less than 0.1 to 3 mL (one drop to half a teaspoonful). These pesticides carry the skull and crossbones in a stop sign. In using these products a respirator and eye protection is required along with all other protective clothing:

phenylmercuric acetate (PMAS, Clean Crop PMA-10)

Moderate Acute Toxicity
These pesticides are dangerous if handled carelessly. The acute oral LD_{50} is 50 to 500 mg/kg of body weight and the acute dermal LD_{50} is 200 to 2000 mg/kg body weight. These pesticides can be fatal by swallowing 3 to 30 mL (half a teaspoonful to 2 tablespoonsful). These pesticides carry the skull and crossbones on a stop sign. In using these products a respirator and eye protector along with all other protective clothing are recommended when handling the concentrate:

cadmium chloride (Caddy)
chlorpyrifos (Dursban)
diazinon (Basudin, Scotts Granular Insecticide I)

Low Acute Toxicity
These pesticides are not fatal unless deliberately ingested in amounts of over 30 mL (1 oz). The acute oral LD_{50} is greater than 500 mg/kg body weight and the acute dermal LD_{50} greater than 2000 mg/kg body weight. Pesticides listed in this publication and not appearing in the lists in this section have low acute toxicities and should be handled with caution. Protective clothing is required. Respirators are advised when used in confined spaces. Eye protection is advisable and other protective clothing should also be worn.

Chronic Toxicity
It is not possible to assess chronic toxicity of a pesticide in the same way as an LD_{50} is used to determine acute toxicity. Instead, a number of tests are performed on animals which help predict whether a pesticide will cause a number of possible long-term effects. Animals are examined for a wide variety of toxic effects such as the production of tumors or abnormalities. Protective clothing and equipment is advisable to reduce exposure and the risk of chronic effects:

For further information on pesticide toxicity see Table 2 on page 7.

BLOOD TESTS FOR THOSE APPLYING PESTICIDES

Organophosphorus and carbamate pesticides are capable of inactivating the serum and the red blood cholinesterase levels. If the activity of cholinesterase falls below a critical level, human poisoning can result as exhibited by fatigue, dizziness, nausea, trembling, blurred vision, difficulty in breathing and other symptoms.

For those working outdoors and applying these groups of pesticides, it is strongly recommended that cholinesterase levels be checked by your family doctor. To be of value the tests should begin prior to using these pesticides and not after applications have commenced, since the normal level per individual can vary considerably, making it difficult to assess the degree of suppression. In this publication the primary insecticides of concern are:

carbaryl (Sevin)
chlorpyrifos (Dursban)
diazinon (Basudin, Scotts Granular Insecticide I)

PROTECTIVE CLOTHING WHEN USING PESTICIDES OUTDOORS

1. **Why Use Personal Protection?** Pesticide formulations vary in their toxicity from slightly to extremely poisonous. Once the pesticide is removed from the container, exposure occurs. The toxicity of the pesticide and the exposure to the user creates a hazard which varies from spray operation to spray operation. Both can be reduced, toxicity by dilution and exposure by protective clothing. The action taken by the applicator to reduce the hazard of a spray operation lessens the risk of poisoning. While the hazard of a situation remains, the risk can be changed by the care and protection followed by the applicator. Wearing the required protective clothing reduces the risk to a minimum.
2. **Risk of each stage in pesticide operation.**
   (1) Handling and mixing concentrate — very high risk
   (2) Rinsing empty containers — high risk
   (3) Application outdoors — low to high risk
   (4) Application indoors — medium to very high risk
   (5) Clean-up, equipment rinsing — medium to high risk
   (6) Reentry into treated area up to 48 hours. — low to medium risk
3. **Exposure can be by way of skin, eyes, mouth, or nose.** Approximately 80-85% of the exposure in most spray operations is during mixing and loading of the concentrate. Field application usually accounts for 15-20% of the exposure. Skin exposure is usually 90 to 100% of the total exposure and around 70% of this is by way of the hands and forearms and 30% involves the rest of the body. Inhalation (nose and mouth) exposure is normally 0.1% but rises to 5-10% with the use of mist blowers and air blast sprayers.
4. **To reduce skin (dermal) exposure** wear impervious gloves (neoprene, rubber, etc.) and waterproof boots, along with coveralls, apron or spray suits and waterproof cap. Coveralls can be reusable or disposable. Reusable coveralls are normally cotton or polyester and should be tightly woven. Polyester is more easily penetrated than cotton. Disposable coveralls are polyethylene and can be laundered several times. Spray suits should be used in highly hazardous conditions as with mist blowers and air blast machines. Eye protection should be practised with all pesticide concentrates.
5. **Respirators are recommended** when handling pesticides with labels carrying the warning stop sign with skull and crossbones that call for respiratory protection. Respirators should be used when spraying all pesticides rated as having a high toxicity or applying any liquified gas. Respirators are available as air purifiers or self-contained units. Respirators come in a wide range of shapes and sizes; consult the label and your nearest safety supply company for advice.
6. **Protective clothing deteriorates and pesticides eventually break through** to the skin. It is wise to check and replace clothing that is worn out, cracked, torn or severely abraded. All protective clothing should be washed after each use, including respirator, boots, gloves and spray suits. After use, decontaminate and dry before storing in a clean and dry place.

7. **Consult the safety supply house** of your choice for appropriate guidance and selection of your protective clothing (see Table 1).

TABLE 1: SAFETY SUPPLY COMPANIES IN ONTARIO PROVIDING PROTECTIVE CLOTHING AND/OR RESPIRATORY DEVICES FOR OUTDOOR PROTECTION AGAINST CERTAIN PESTICIDES

Respiratory Devices Manufactured By	Available From	Telephone
American Optical	AOCO Limited, Subsidiary of American Optical Corporation, 80 Centurian Drive, Markham L3Y 5Y5 Branches: Hamilton and Belleville	(416) 479-4545
H.S. Cover (York)	Levitt-Safety Ltd., 33 Laird Drive, Toronto M4G 3S9 Branches: Kitchener, London, Ottawa, Sarnia, Stoney Creek, Sudbury and Thunder Bay	(416) 425-8700
Kasco Helmets	The St. George Co., R.R. #1, St. George N0E 1N0	(519) 442-2046
Mine Safety Appliances	MSA Canada Inc., 148 Norfinch Drive, North York M3N 1X8	(416) 667-9400
3M Canada Inc. Occupational & Environmental Safety Division	A wide range of distributors Contact: P.O. Box 5757, London, Ontario N6A 4T1	(519) 451-2500
North	Siebe-North Inc., 26 Dansk Court, Rexdale M9W 5V8	(416) 675-2810
Racal Airstream	Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto) L4B 1E7 Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor	(416) 222-4111 (416) 222-2111
Safety House	Safety House of Canada Ltd. 1275 Castlefield Ave., Toronto M6B 1G4 Branches: Kitchener, London, Orillia, Ottawa, St. Catharines and Stoney Creek	(416) 789-0631
Scott	Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto) L4B 1E7 Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor	(416) 222-4111 (416) 222-2111
Survivair	Levitt-Safety Ltd., 33 Laird Drive, Toronto M4G 3S9 Branches: Kitchener, London, Ottawa, St. Catharines, Sarnia, Stoney Creek, Sudbury and Thunder Bay	(416) 425-8700
Willson	Safety Supply Canada, 90 West Beaver Creek Road, Richmond Hill (Toronto) L4B 1E7 Branches: Hamilton, Kingston, Kitchener, London, St. Catharines, Sarnia, South Porcupine, Thunder Bay and Windsor	(416) 222-4111 (416) 222-2111

Many of the companies listed above have dealer outlets in addition to branch outlets. For details of dealer outlets, contact the supply company of your choice.

TABLE 2: CLASSIFICATION OF CHEMICALS REGISTERED FOR TURFGRASS

Trade name(s) given in this publication		Common name	LD_{50} (m.g. a.i./kg)*	Chemical Family
Fungicides				
Arrest	(3)	carbithiin/ oxycarboxin/thiram		anilide
Benlate, Tersan 1991	(3)	benomyl	9590	benzimidazole
Calo-clor	( )	mercuric/mercurous chloride		inorganic
Captan	(2)	captan	9000	phthalimide
Caddy	(2)	cadmium chloride	88	
Daconil 2787	(3)	chlorothalonil	10000 +	aromatic hydrocarbon
Dyrene	(3)	anilizine	2700	triazine
Easout, Scotts Fertilizer + DSB Fungicide PMAS,	(3)	thiophanate-methyl	7000 +	benzimidazole
Clean Crop PMA-10	(2)	phenyl mercuric acetate	22	inorganic
Quintozene, Scotts FFII, Plant-Prod 0-0-6 with 15.4% quintozene	(3)	quintozene	1750-2000	aromatic hydrocarbon
Rovral, Rovral Green	(3)	iprodione	3500	dicarboximide
Safer's De-Moss		soaps		
Scotts Broad Spectrum Fungicide	(3)	PMA + thiram		
Terraneb	(3)	chloroneb	5000 +	chlorinated hydrocarbon
Thiram, Spotrete -F	(3)	thiram	780	dithiocarbamate
Insecticides				
Diazinon, Basudin Scotts Granular I	(2)	diazinon	108	organophosphate
Dursban	(3)	chlorpyrifos	135	organophosphate
Sevin	(3)	carbaryl	400-850	carbamate
Herbicides				
Acclaim	(3)	fenoxaprop-ethyl		phenoxy-phenoxy
Banvel	(2)	dicamba	1040	benzoic acid
Basagran	(3)	bentazon	1100	benzothiadiazine
Betasan,Pre-San	(3)	bensulide	770	benzene sulfonamide
Compitox, Mecoprop	(3)	mecoprop	930	phenoxy
Dacthal	(3)	chlorthal dimethyl	3000 +	phthalate
2,4-D (many mfg.)	(2)	2,4-D 2,4-dichlorophenoxyacetic acid		phenoxy
	(2)	2,4-D/dicamba		phenoxy/benzoic acid
	(2)	2,4-D/dichlorprop		phenoxy/phenoxy
	(3)	2,4-D/mecoprop		phenoxy/phenoxy
	(3)	2,4-D/mecoprop/dicamba		phenoxy/phenoxy/benzoic acid
Gramoxone	(2)	paraquat	157-207	bipyridylium
MCPA amines	(3)	MCPA	700 - 1000	phenoxy
Roundup	(3)	glyphosate	4320	N–(phosphonomethyl) glycine
Royal MH-60 SG	(3)	maleic hydrazide		unique

The numbers within the brackets ( ) identify the Schedules in which the BRAND NAME products listed in this Table are classified under the Pesticides Act.

Explanation of Schedules

Schedule 1 Restricted Use permit only.
Schedule 2 Restricted to agriculturalists, licensed exterminators and registered custom sprayers.
Schedule 3 May be available for "Domestic" purposes if so registered.
Schedule 4 "Domestic" products only.
Schedule 5 Limited to application on agricultural land.
Schedule 6 Similar to Schedule 4 but may be registered for agricultural/commercial use.

For further information on the regulatory aspects of the classification, please contact the Ministry of Environment office nearest you.

** The relative toxicity of a pesticide may be referred to as its LD_{50}. This is the amount of the active ingredient (a.i.) of the chemical in milligrams used per kilogram of test animals (usually female rats) that kills 50% of the test animals. This is commonly measured as the Acute Oral LD_{50} (above) which refers to the chemical ingested through the mouth or nose. Dermal LD_{50} or skin penetration figures are available. The higher the LD_{50} value, the less toxic the product is to humans.*

WASHING AND LAUNDERING PROTECTIVE CLOTHING

To keep your protective clothing and equipment functional, clean it thoroughly. Never allow children or pets to come into contact with contaminated clothing or equipment. To this end, launder clothing promptly, wash and store other items used for personal protection and rinse down spray equipment and store so as to avoid children playing on it. Here are some general guidelines for cleaning items for personal protection.

(1) **Fabric Clothing** If fabric clothing is saturated with the concentrate of a highly toxic pesticide, then discard the clothing. Remove the clothing carefully and immediately place it in a plastic trash bag and dispose with garbage. Wear rubber, vinyl, or plastic gloves when handling severely contaminated clothing. Presoak and double launder clothes that may have been contaminated by a normal spray operation, preferably twice a day but at least at the end of the work day, following these guidelines:

- Wash contaminated clothing separately from all other clothing.
- Prerinse clothing outdoors by spraying or hosing down.
- Presoak in a suitable container such as a large bucket or tub; or use the prewash cycle of an automatic washer, with detergent.
- Pre-wash, solvent-based products have been found to be effective on EC formulations.
- Wash clothes using hot water, the highest water level, and a regular hot super wash cycle.
- Use heavy-duty liquid detergents for all pesticides and use adequate amounts (see laundry detergent box).
- Wash only a few contaminated garments at a time.
- Use two complete wash cycles each with a double rinse.
- After washing, run another wash cycle with detergent and no clothing to decontaminate the washing machine.
- Line dry to avoid a build-up of pesticide residues in the dryer.

(2) **Rubber, vinyl, or plastic boots and gloves** To avoid getting pesticide on your hands, wash the outside of boots and gloves with detergent and water before removing. After taking off boots and gloves, wash them inside and out with detergent and water, rinse thoroughly, and dry in a well-ventilated area.

(3) **Chemical-resistant clothing, goggles, and face masks** Wash plastic or rubber clothing and equipment with detergent and water, rinse thoroughly, and dry in a well-ventilated area.

PEST RESISTANCE TO INSECTICIDES, FUNGICIDES AND MITICIDES

Many of the pesticides recommended have a very specific mechanism of action, that is, they act on a single system or sit in the organism. These materials should not be used continuously and repeatedly in a season-long program since this will increase the chances of the development of pest resistance. Examples of these types of compounds are Tersan 1991, Easout, and Rovral.

Pests are said to be resistant when they are able to survive exposure to rates of pesticides that previously controlled them. Generally, resistance to a pesticide develops after repeated exposure to a specific chemical. Resistance occurs because a few naturally occurring resistant individual pests survive after each spray, while the susceptible portion of the population is killed. These resistant survivors multiply and gradually replace the susceptible ones. Eventually only a resistant population remains, which cannot be controlled by the pesticide.

The development of resistance to pesticides can occur very quickly. The same chemical should not be used repeatedly without being alternated with a different chemical or without being used in combination with other chemicals having a different mode of action. This practice will reduce the likelihood of resistance developing in the pest population.

It should be noted that several pesticides may act similarly. For example, Tersan 1991 and Easout act on the same site and if resistance develops to one, it is likely to apply also to the other. This is called cross-resistance. Thus, alternating these compounds will not be useful. Rather, they should be alternated with fungicides with different modes of action, as for example, captan or Daconil.

PESTICIDE INJURY TO CROPS

Although insecticides and fungicides have been selected and formulated to avoid plant injury, damage can still occur under some conditions. In addition to the precautions mentioned in this publication, there are a number of others which should be observed:

1. Apply sprays when the drying condition is fast. Some chemicals break down to components which are injurious to plant tissues if they are permitted to stay wet.
2. Apply sprays when the temperature is below 27°C. The spray deposits serve as a lens and concentrate the heat on the plant tissues.
3. Be particularly careful when plants have been under growth stress such as prolonged periods of drought, excessive cloud cover, extremely low or high temperatures.
4. Apply sprays soon after mixing. Undesired chemical change may take place with some chemicals if the sprays remain in the tank for prolonged lengths of time, for example, overnight. In other cases, the chemicals may settle out and clog the lines.

REDUCE BEE POISONING

Bees are essential for the pollination of most trees and small fruits. Insecticides, many of which kill bees, are required for insect control. With careful management, you can obtain both pollination and insect control. You can protect the bees by following these suggestions:

1. **Do not apply insecticides while tree fruits are in bloom. The "Bees Act" makes it an offence to do so in Ontario.**
2. Time of treatment is important. In general, daytime treatments, when bees are foraging in the field, are most hazardous. Insecticide applications in the very early morning or evening are safest.
3. If there is a risk of honey bee poisoning, try to choose an insecticide that is not highly toxic to the bees.

PESTICIDE DRIFT

Pesticide drift can leave unwanted residues on adjacent crops, be a hazard to people and livestock nearby or reduce the amount of material in the target area as to be ineffective. Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by:

1. correctly calibrating and maintaining spray equipment,
2. correctly operating the equipment,
3. being aware of the toxicity of the pesticide in use,
4. being aware of the weather conditions.

For more information consult OMAF Factsheet *Pesticide Drift*, Agdex 607 or Canadex 607 *Pesticides: Effects of Drift and Droplet Size*.

AERIAL APPLICATION

Aerial applicators must be licenced by the Ontario Ministry of the Environment to apply pesticides. In addition, permits are required from the Ontario Ministry of the Environment under the authority of the Pesticides Act 1973 for the application of Schedule 1 and 5 pesticides and Schedule 2 hormone-type herbicides. The area will be inspected by Ministry personnel to ensure safety of application.

It is an offence under the Federal Pest Control Product Act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honey bees, for example, Sevin (carbaryl).

Applications should not be made if the wind is blowing. Some drift occurs even on the stillest day and to keep it to a minimum, apply pesticides in the evening or early morning.

Be sure that the product to be used is specified, along with rate of application, in the contract.

WEED CONTROL

Recommendations for weed control on turfgrass are included in this publication. For complete weed control recommendations, including comprehensive information on chemicals, safety precautions and calibration and care of sprayers, use Ontario Ministry of Agriculture and Food Publication 75, *Guide to Weed Control*.

Herbicide Use Precautions

Spray drift can damage or destroy susceptible crops for a great distance from the sprayer. Use extreme caution when applying hormone-like herbicides (2,4-D, MCPA, etc.) near susceptible plants or crops. These herbicides should only be applied when it is calm (either early morning or late evening) or when a very light wind is blowing away from any susceptible plants. Use low pressures whenever possible as only enough pressure is required (200-250 kPa) to get uniform distribution. High pressures produce many small droplets which drift. **Do not use the same sprayer for applying 2,4-D and similar herbicides as you use to apply insecticides and fungicides.** Drain and wash out the sprayer immediately after use. Do not empty herbicide mixtures or wash water into drainage ditches, streams or ponds or places where the herbicides can be washed into them. Do not mix different herbicides, or herbicides with other pesticides or foliar fertilizers, unless recommended by competent authorities.

PESTICIDE STORAGE

General Storage:

The Ontario Pesticides Act and Regulation 751 require that all pesticides be kept out of the reach of children, irresponsible persons, pets and livestock. They should be stored in a locked facility away from food for humans, and feed for animals. Herbicides should be stored separately from other pesticides to avoid possible contamination. Storage area should be adequately ventilated.

Special Storage:

1. Schedule 1, 2 and 5 pesticides must be stored in a storage facility which is ventilated to the outside atmosphere. A placard bearing the words **"Chemical Storage Warning—Authorized Persons Only"** in block capitals must be affixed to the outside of each entrance. Entry to the storage facility should only be made by the person responsible for the pesticide, or with his permission.
2. **Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers.** Also see OMAF Factsheet, *Farm Storage of Pesticides*, Agdex 607.
3. In areas where flooding has been a frequent occurrence, fertilizers and pesticides must be stored above the known high water mark to avoid contamination of the flood waters. Contamination of water by these chemicals can and has led to serious health problems affecting humans, domestic animals as well as fish and wildlife.

DISPOSAL OF PESTICIDE CONTAINERS AND CONTAMINATED MATERIAL

1. Pesticide containers and any paper or other material used to clean up spills should be buried or burned. Make sure that people and animals are kept away from the smoke, and that the smoke is not directed toward buildings, highways, roads, or outdoor public areas.
2. Unrinsed containers can contain as much as 3% of the original formulation. If this amount of toxic pesticide is discarded with the drum, it could be dangerous to other people handling it, or to the environment (for example, your water supply). Failure to rinse is also wasteful; why not use that 3% for the purpose for which it was purchased, to control the pest!

Rinse all empty metal or glass containers three times with water and add washings to the spray tank. Or, use a rinsing device. These rinsers can be used to puncture the bottom of a metal or plastic drum, and to rinse the residue left in the container directly into the spray tank. This procedure takes less than a minute. The rinsed containers may be crushed, buried and covered by at least 50 cm of soil, away from any watercourse or water table.

PUBLIC NOTICE PROGRAM UNDER THE PESTICIDES ACT

Public concerns related to the use of pesticides have largely focused on their application to publicly accessible areas such as residential lawns, playing fields and parks where children, adults and pets may be exposed. Increasingly, the public is demanding to know where and when pesticides will be used, so as to be able to take suitable precautions to avoid exposure.

Regulation 751 under the **Pesticides Act** has therefore been amended to require posting/notification of pesticide use in Ontario on public land areas, and on residential land areas where pesticides are applied by licensed applicators.

THE APPLICATOR'S RESPONSIBILITY

The Applicator is responsible for obtaining suitable weatherproof signs in accordance with the Regulation, and completing them legibly for the particular application which is being made. The Applicator is responsible for ensuring that the signs are posted 24 hours before application in the case of certain public lands and at the time of application where private residential properties are being treated. The

Applicator must ensure the removal of the signs on the third day after application of the pesticide from both categories of land.

FURTHER INFORMATION

For further details concerning the above Regulation, contact the local Regional Office of the Ministry of the Environment.

SOIL MANAGEMENT AND FERTILIZER USE

FERTILIZING TURF

Soil Testing

Soil testing and plant analysis are currently the most accurate tools available to determine the amount of fertilizers and lime which should be applied to turf. The application of phosphorus and potassium to turf areas should be based on soil tests, plant analysis, or preferably both. Soil samples for turf should be analyzed by a commercial laboratory accredited by the Ontario Ministry of Agriculture and Food. All analyses are on a fee for service basis. The laboratories must meet and maintain established levels of proficiency on the basic tests to maintain their accreditation. For further information on the accredited laboratories, the tests performed and fee schedules, contact any county office of the Ontario Ministry of Agriculture and Food. Each county office has generic submission forms and sample boxes. OMAF staff will continue to provide assistance on technical interpretation of test results, if indicated on the submission at no charge to the grower.

Recommendations are made on the basis of four types of turfgrass management programs:

(1) Greens and tees
(2) Fairways, athletic fields and lawns
(3) Nursery sod
(4) Low use Turf

Soil Sampling

Soil may be sampled by using a soil sampling tube, shovel or a cup changer. The core should be taken to a depth of 15 cm except on greens and tees where a depth of 7.5 cm is preferable as this depth is more closely related to the active root feeding zone of bentgrass. At least 20 cores (10 to 15 on greens) should be taken for each sample. Due to the variability which may exist from green to green or on different areas of a field, it is very important that each unit be represented by a separate sample. Problem areas should also be sampled separately. The thatch layer of the core should be discarded and the cores mixed thoroughly in a clean plastic pail. Fill the sample box and till out an information sheet specifying the type of turf you require a recommendation for.

When to Sample

On well established turfgrass areas, representative sampling every 2 to 3 years may be adequate. On newly established turfgrass areas and on sand root zones annual testing is recommended to more closely monitor the nutrient status. Nitrogen and potash levels can change quickly in sand root zones or if clippings are removed.

TABLE 3: PHOSPHORUS AND POTASSIUM REQUIREMENTS FOR TURF AND NURSERY SOD

Soil Phosphorus (0.5 N sodium bicarbonate)	Greens, tees, fairways, lawns, athletic fields	Nursery sod	Low use turf	Soil Potassium (1 N amm. acetate)	Greens & tees	Fairways, lawns, & athletic fields	Nursery sod	Low use turf
ppm P in soil	phosphate (P_2O_5) required — kg/ha			ppm K	Potash (K_2O) required — kg/ha*			
0-3	370 L	230 L	90 L	0-15	400 L	200 L	140 L	90 L
4-5	360 L	210 L	80 L	16-30	360 L	180 L	120 L	80 L
6-7	350 L	200 L	70 L	31-45	320 L	160 L	80 L	70 L
8-9	340 L	190 L	60 L	46-60	280 L	140 L	60 L	50 L
10-12	320 L	170 L	40 M	61-80	200 L	100 L	50 M	30 M
13-15	300 L	150 M	30 M	81-100	160 L	80 M	40 M	20 M
16-20	260 L	130 M	20 M	101-120	120 M	60 M	30 M	20 M
21-25	220 M	110 M	0 H	121-150	80 M	40 M	30 M	0 MH
26-30	170 M	90 M	0 H	151-180	40 M	40 M	0 H	0 VH
31-40	120 M	70 H	0 VH	181-210	0 H	0 H	0 VH	0 VH
41-50	70 H	50 H	0 VH	211-250	0 VH	0 VH	0 VH	0 VH
51-60	40 H	40 H	0 VH	250+	0 E	0 E	0 E	0 E
61-80	0 VH	30 H	0 E					
80+	0 E	0 E	0 E					

** Above rates are total yearly applications. Not more than 90 kg/ha should be applied in any one application except for nursery sod which may receive the total yearly amount in one application before seeding.*

TABLE 4: NITROGEN REQUIREMENTS FOR TURF AND NURSERY SOD**

Greens & tees	– Nitrogen to be recommended by turf specialist; not more than 400 kg N/ha in 6-8 applications. 250 kg N/ha is usually sufficient for established greens. Not more than 50 kg N/ha per application*.
Lawns, fairways & athletic fields	– Nitrogen to be recommended by turf specialist; not more than 200 kg N/ha applications if clippings are left on. Not more than 30 kg N/ha (.3 kg/100m^2) per application.
Nursery sod	– Prior to the final cultivation before seed bed preparation, apply 90 kg N/ha where the soil is a coarse texture. Where the soil is a medium or fine texture, is high in organic matter, or has a history of luxuriant growth, reduce the initial application to 50 kg N/ha. On turf with less than 85% groundcover, apply 70 kg N/ha as early as feasible the spring after seeding. Reduce the rate to 35 kg N/ha where vigorous growth is evident. In mid or late June apply 50 kg N/ha. Withhold further applications until three weeks prior to harvesting at which time apply 35 kg N/ha. Where sod is held over a second winter apply 45 kg N/ha in September, April, and every 10 weeks until harvest.
Low use turf	– Nitrogen to be recommended by turf specialist; 50 kg N/ha applied once per season.*

* *Divide kg/ha by 100 to obtain kg/100 m^2.*
** *If clippings are not removed.*

Soil Tests from Other Laboratories

Each year there are requests to interpret soil test results from other laboratories. Provided the other laboratory uses the identical chemical tests as the OMAF accredited service and expresses their test results in the same units, the OMAF fertilizer requirements for phosphate and potash can be used for interpretation. However, this is rarely the case. Only soil tests using chemical extractants which have been calibrated on Ontario soils can be relied on to provide accurate fertilizer recommendations.

A number of laboratories provide tests such as exchange capacity, nitrogen, iron, copper and sulfur. These are not provided by the OMAF soil testing service because they have not been found to contribute to better fertilizer recommendations. Research has shown that use of exchange capacity to adjust recommendations on Ontario soils can lead to less reliable guidelines than are now provided.

Nitrogen

There is no satisfactory soil test available for nitrogen under Ontario conditions.

The color, density and vigor of turf is strongly affected by the amount of nitrogen fertilizer used. The amount of nitrogen should be adjusted for the desired growth response. The recommendations in Table 4 can be used as a guideline. A common rule of thumb for bentgrass greens during the summer months is to use N rate at which 2 baskets of clippings are removed per day per 550 m^2. The specific application rate depends on the type of nitrogen carrier utilized. More frequent applications are required with water soluble carriers and less frequent with slow-release carriers. Time of application is influenced by many factors including turf species, turf use, turf conditions, soil type, desired level of quality, weather conditions, length of growing season, whether or not clippings are removed and type of fertilizer used. Areas with increased use and irrigation will require more nutrients (nitrogen and potassium most affected). Older turf requires less nitrogen than younger turf. Do not apply more than 0.5 kg actual N/100 m^2 per application (see Table 4). More frequent fertilizer applications at a lower rate are more desirable, especially for summer applications. Granular fertilizer applications on golf course greens of less than .125 kg N/100 m^2 could result in uneven coverage and 'freckling' of the turf.

Nitrogen may be obtained from a complete fertilizer or by using ammonium nitrate, urea or slow-release nitrogen materials. Where water soluble ammonium nitrate or urea are used they should be watered in to avoid foliar burn.

Avoid fertilizing during periods of heat or drought stress or when conditions favour active disease development.

Early spring fertilization is not recommended as this tends to promote excessive shoot growth; application of nitrogen should be delayed until early June. Application of a fertilizer high in nitrogen between October 20 and November 5 results in better root growth, early green-up and moderate growth rates in the spring. The application should be delayed if fall weather is warmer than normal.

For low use turf which is only fertilized once per year, early fall application is recommended. Rates should be kept sufficiently low to prevent lush growth late in the fall.

Nitrogen Equivalency Table

Fertilizer recommendations are often based on actual (elemental) nitrogen applied. By using the following calculation you can determine the application rate of any nitrogen fertilizer formulation. For example:

To apply 0.5 kg actual N/100 m^2:

$$\frac{100}{\%\ \text{Nitrogen in the fertilizer}} \times 0.5\ \text{kg N/100m}^2 = \text{kg fertilizer/100m}^2$$

To convert to kg/ha multiply by 100

TABLE 5: NITROGEN EQUIVALENCY TABLE
To obtain 0.5 kg N/100 m²

Nitrogen % in the fertilizer	kg/100m²
5	10
6	8.33
7	7.14
8	6.25
9	5.55
10	5.00
11	4.55
12	4.16
13	3.84
14	3.57
15	3.33
16	3.12
17	2.94
18	2.77
19	2.63
20	2.50
21	2.38
22	2.27
23	2.17
24	2.08
25	2.00
26	1.92
27	1.85
28	1.79
29	1.72
30	1.67
31	1.61
32	1.56
33	1.50
34	1.47
35	1.43
46	1.09

Nitrogen Sources

Water Soluble Sources
Ammonium nitrate, Ammonium sulfate, Potassium nitrate, Urea

Slow Release Sources
Activated sewage sludge, IBDU, urea formaldehyde, methylene urea, Sulfur-coated urea

General Comments
Water soluble sources of nitrogen fertilizers are generally less expensive. However, they are also more prone to leaching and have a higher burn potential. Therefore, if used these sources of nitrogen should be applied more often at lower rates and should be watered in after application.

Slow release sources of nitrogen are generally more expensive but less prone to leaching, have a lower burn potential, and are more slowly available.

Phosphorus and Potash
The application of phosphorus and potassium to turf areas should be based on a soil test. The requirement of these nutrients are presented in Tables 6 and 7. **This table should not be used with soil test readings from other soil testing laboratories unless the methods used are identical to those used by the OMAF accredited laboratory**. Phosphorus is important for the establishment of turf grasses.

Where a soil test is not available, a rough estimate of requirements can be obtained from these tables using the following guidelines:

1. Where the turf has been fertilized regularly for a number of years or heavily in recent years, use the rates of phosphate and potash recommended for the MEDIUM soil test rating.
2. If the field has received little fertilizer in the past, use one of the rates recommended for a LOW soil test rating.

Phosphorus does not leach readily from the soil and may accumulate to very high levels. Potash leaches to some degree from sandy and organic soils. In contrast, nitrogen leaches quite readily.

TABLE 6: PHOSPHORUS SOURCES

Phosphorus Sources	P_2O_5 %
Superphosphate	20
Triple superphosphate	44 to 46
Monoammonium Phosphate	48 to 52
Diammonium Phosphate (18-46-0)	46

TABLE 7: POTASSIUM SOURCES

Potassium Sources	K_2O %
Potassium chloride (muriate)	60 to 62
Potassium sulfate	50
Sulfate of Potash magnesia (11% Mg)	22
Potassium nitrate	44

Micronutrient Tests
Micronutrient deficiencies in turf are rare.

Manganese and zinc tests are provided by the OMAF service. No acceptable soil test for copper or boron is available in Ontario. Plant analysis can give some indication of micronutrient status.

With the exception of some areas in northwestern Ontario, there appear to be adequate supplies of sulfur for crop production.

Great care is required to prevent contamination of soil samples to be tested for micronutrients. Do not use galvanized (zinc plated) soil sampling tubes to take soil samples for micronutrient tests. Do not use metal containers to collect and mix samples.

Plant Analysis
Plant analysis measures the nutrient content of plant tissue. Comparing the results against the "normal" range for turfgrasses in Table 15 can indicate whether nutrient supply is adequate.

Plant analysis is a useful supplement to soil testing for the evaluation of the fertility status of turfgrasses. It is quite independent of soil testing and can provide a valuable second opinion, especially for phosphorus, potassium, magnesium and manganese. It is also the only test for nitrogen, and the micronutrients.

Plant analysis has limitations. Expert help in interpreting the results is often needed since plant analysis does not always indicate the cause of the deficiency or the amount of fertilizer required to correct it.

TABLE 8: DESIRABLE NUTRIENT CONCENTRATIONS IN DRIED TURFGRASS CLIPPINGS*

Element	Normal Range
N	2.5 - 6.0
P	.15 - .55%
K	0.9 - 4.0%
Ca	0.2 - 4.5%
Mg	0.15 - 1.0%
Mn	20 - 140 ppm
Zn	10 - 100 ppm
Cu	5 - 30 ppm
B	3 - 30 ppm

**This information is provided as a guideline until more information is available. Nutrient levels will vary depending on turfgrass species.*

Sampling

Approximately 500 grams of clippings are required for a tissue sample. A sample can be collected from the mower baskets. When taking samples for plant analysis take care not to contaminate the sample with soil. Even a small amount of soil will cause the results to be invalid, especially for manganese. Iron analysis is not likely to be useful because of contamination. Do not topdress, fertilize or apply any chemical sprays prior to taking the tissue sample as this will contaminate the sample. The sample should be taken immediately to the laboratory dried by placing in a thin layer on a clean surface. Stir the clippings occasionally to help them dry uniformly and then place in sample bag.

A soil sample taken at the same time as the clipping sample will provide additional results for comparison.

Adjusting Soil pH

Soil pH is a measure of acidity or alkalinity on a scale from 0 to 14. The middle of the scale (7) is neutral, with values below 7 being increasingly acid and values above 7 increasingly alkaline. Most Ontario soils are between 5.0 and 8.0. As soil acidity increases the solubility of elements such as iron and manganese also increases; most turf species grow well in soil pH 5.5–7.5.

Raising pH

Lime is used to raise pH and would be useful where soil pH is low. General lime applications for most crops are listed below based on buffer pH.

The Buffer pH

Different soils with any one soil pH value, for example, 5.2 will require different amounts of lime to bring the pH to a particular desired level, i.e., 6.0, depending chiefly on the clay and organic matter content of each soil. The soil pH is used to determine which soils need to be limed but a separate soil test, the buffer pH, is run to determine the amount of lime required. For soils needing lime (based on soil pH), use the Lime Requirement table to determine the amount of lime required to reach different "target" soil pH values required for different crops.

Limestone Quality

Calcitic limestone consists largely of calcium carbonate. Dolomitic limestone is a mixture of calcium and magnesium carbonates. Dolomitic limestone should be used on soils with a magnesium soil test of 100 or less as it is an excellent inexpensive source of magnesium for acid soils. On soils with magnesium tests greater than 100, either calcitic or dolomitic limestone may be used to increase soil pH.

Two main factors affect the value of limestone for soil application. One of these is the amount of acid a given quantity of limestone will neutralize when it is totally dissolved. This is called the "neutralizing value" and is expressed as a percentage of the neutralizing value of pure calcium carbonate. A limestone which will neutralize 90% as much acid as pure calcium carbonate is said to have a neutralizing value of 90. In general, the higher the calcium and magnesium content of a limestone, the higher the neutralizing value.

The second factor which affects the value of limestone as a neutralizer of acidity is the particle size. Limestone rock has much less surface area to react with acid soil than finely powdered limestone; and hence it neutralizes acidity much more slowly—so slowly that it is of little value.

Lowering pH

Sulfur can be used to lower pH (see Table 5). Do not apply more than 2 kg elemental sulfur per 100 m^2 on established turf. Lower rates should be used on high sand content soils such as putting greens. Soils with pH above 7.0 frequently contain too much lime to permit lowering of pH with sulfur—lime content can be measured.

The rate of pH change is affected by temperature, moisture and aeration conditions. The preferred time for applying materials to adjust the pH is spring, late fall or after cultivation practices such as coring. Major pH adjustments should be done prior to turf establishment and incorporated into the root zone.

TABLE 9: LIME REQUIREMENTS TO CORRECT SOIL ACIDITY BASED ON SOIL pH AND SOIL BUFFER pH

Buffer pH	Target Soil pH = 6.5 Lime if soil pH below 6.1	Target Soil pH = 6.0 Lime if soil pH below 5.6
	Ground limestone required — t/ha (Based on an Agricultural Index of 75)	
7.0	2	0
6.5	3	2
6.0	9	6
5.5	17	12
5.0	20	20

TABLE 10: SOIL ACIDIFICATION TO pH 5.0 WITH SULFUR

Initial pH	Soil Type	
	Sand kg/100 m^2*	Loam kg/100 m^2*
7.0	7.4*	22.6
6.5	6.0	17.5
6.0	4.0	12.0
5.5	2.0	6.0

**kg of elemental sulfur per 100 m^2 for 2 successive years.*

TABLE 11: SOIL CONDUCTIVITY READING INTERPRETATION

Conductivity "salt" reading millisiemens/cm	Rating	Plant Response
0-0.25	L	Suitable for most plants if recommended amounts of fertilizer are used.
0.26-0.45	M	Suitable for most plants if recommended amounts of fertilizer are used.
0.46-0.70	H	May reduce emergence and cause slight to severe damage to salt sensitive plants.
0.71-1.00	E	May prevent emergence and cause slight to severe damage to most plants.
1.00	E	Expected to cause severe damage to most plants.

For greenhouse soils the OMAF accredited soil test uses a larger soil sample and measures conductivity on a saturation extract. For greenhouse crops using that method, conductivity readings up to 3.5 millisiemens/cm are acceptable.

Soluble Salts in Soil

High concentrations of water soluble salts in soils can prevent or delay germination of seeds and can kill established plants or seriously retard their growth.

Ontario soils are naturally low in soluble salts. Soluble salts therefore rarely cause a problem in crop production and are not routinely measured in soil tests.

Soluble salts in soils can result from excessive applications of fertilizers, runoff of salts applied to roads and chemical spills. A given amount of salt in a soil provides a higher soil water salt concentration if the amount of water is small. Soluble salts also interfere with the uptake of water by plants. For these reasons, plant growth is most affected by soluble salts in periods of low moisture supply (during drought periods).

Soluble salts can be measured readily in the laboratory by measuring the electrical conductivity of a soil water slurry. The higher the concentration of water soluble salts, the higher the conductivity. The following table provides an interpretation of soil conductivity readings in Ontario field soils in a 2:1 water:soil paste mixture, the procedure used by the OMAF accredited laboratories.

TURF MANAGEMENT

INSECTS AND DISEASES OF TURF AND THEIR CONTROL**

There are many factors that will influence the occurrence of insect and disease problems on turf. Damage can be minimized by good cultural practices that encourage vigorous turf growth that will be less susceptible to insect and disease problems. Resistant turf species and varieties should be used when possible. Maintaining balanced fertility and soil pH, avoiding drought stress, thatch control, and proper mowing and irrigation practices are all factors to consider as part of an integrated approach to pest control on turf.

The incidence of foliar diseases can be prevented by reducing the period of leaf wetness. Water turf during the day when possible rather than during the night. Reducing shade conditions and increasing air circulation will also reduce the period of leaf wetness.

Early detection of pest problems is the key to preventing extensive turf damage. Observe the parts of the plant that are being damaged and note symptoms that may occur such as yellowing/browning of leaves, thinning of turf, die-back or wilting, patchy appearance or the presence of insects or visible mycelium. Some disease and insect problems are more prevalent on certain turfgrass species. Knowing the main pest problems of a specific species may help in diagnosis of the problem.

Proper timing of chemical applications is critical for achieving pest control. Be aware of the season of occurrence, life cycle and damaging stage of the pest as this may influence selection and application of your control method.

INSECT CONTROL

Pest	Control	Rate per 100 m^2	Remarks Use sufficient water for thorough coverage. Follow label directions.
Annual bluegrass weevil, Hyperodes weevil *(Hyperodes maculicollis)*	Dursban 2E Dursban 4E	90 mL 45 mL	Mainly a problem on closely mowed turf composed mainly of annual bluegrass. Spray suspected problem areas in mid-April and again in mid-May or as recommended.
Ant	diazinon 500 EC diazinon 5 G Sevin 80 S Sevin 50 WP Sevin XLR Dursban 2E Dursban 4E	150 mL 0.75 - 1.5 kg 125 g 200 g 210 - 290 mL 45 mL 23 mL	Repeat in 7-10 days if necessary. Do not water for 2 days after application. Spot treatment on ant hills is usually effective.
Hairy chinch bug *(Blissus leucopterus hirtus)*	Sevin 80 S Sevin 50 WP Sevin XLR diazinon 500 EC diazinon 5 G Dursban 2E Dursban 4E Scotts Insecticide One	125 g 200 g 210 - 290 mL 150 mL 7.5 - 1.5 kg 45 mL 23 mL 1.57 kg	The smaller stages of chinch bug nymphs are easier to control. If damage was significant the previous year, apply when damage or large numbers of chinch bugs are noticed. For best results the lawn should be moist at time of treatment. Do not water for 2 days after application.
European chafer *(Rhizotrogus majalis)*	Dursban 2E Dursban 4E	90 mL 45 mL	Apply when grubs are young and actively feeding near the soil surface in late July to mid-September or as recommended. Immediately after spraying irrigate the treated areas with 1 to 2 cm of water to wash product into underlying soil. Control is required if approximately five to ten grubs per. 1 m^2 in non-irrigated turf or more than 20 grubs per .1 m^2 on irrigated turf are observed.
Japanese beetle *(Popillia japonica)*	Dursban 2E Dursban 4E	90 mL 45 mL	
Cutworm (various species)	Sevin 80 S Sevin 50 WP Sevin XLR Dursban 2E Dursban 4E	125 g 200 g 210 - 290 mL 45 mL 22.5 mL	Repeat in 7-10 days if necessary. Apply to turf. Water in after treatment. Do not mow turf 1-3 days after treatment. Spray when cutworms first appear and repeat as needed. Treat in early morning or early evening.
Sod webworm, lawn moths *(Pediasia sp.)*	Sevin 80 S Sevin 50 WP Sevin XLR Dursban 2E Dursban 4E diazinon 500 EC Scotts Insecticide One diazinon 5 G	125 g 200 g 210 - 290 mL 45 mL 22.5 mL 150 mL 1.57 kg 0.75 - 1.5 kg	Do not water for 2 days after application. Do not mow turf for 1-3 days after treatment. Treat in early morning or early evening. Approximately six or more caterpillars per .1 m^2 (1 sq. ft.) is a level requiring control.
White grubs	Dursban 2E Dursban 4E Scotts Insecticide One diazinon 500 EC	90 mL 45 mL 1.57 kg 150 mL	Apply to lawn. Water into soil after treatment. Approximately three to five grubs per .1 m^2 (1 sq. ft.) on non-irrigated turf is a level requiring control.

TABLE 12: TURF INSECTS — SUMMARY OF LIFE CYCLES, HABITAT, DAMAGE AND FACTORS AFFECTING DISTRIBUTION

	Immature Stage	Adult Stage	Overwintering Stage	Yearly Generations	Factors affecting Distribution
Soil Inhabiting Insects (attack roots)					
Black fairway beetle *(Black turfgrass ataenius)*	grub*	scarab beetle	adult	one, partial second	Moist soil, bluegrass, bentgrass.
White grubs	grub*	scarab beetle	adult or larva	many have 3 year cycle	Sandy soil.
European chafer	grub*	scarab bettle	larva	one	Sandy soil, commonly found in Niagara Peninsula and shore of Lake Erie.
Japanese beetle	grub*	scarab beetle	larva	one	
Bluegrass billbug	larva*	weevil	adult	one	Prefers bluegrass but will feed on other grasses.
Thatch Inhabiting Insects (attack leaves and stems)					
Annual bluegrass weevil	larva*	weevil	adult	one	Prefers annual bluegrass.
Hairy chinch bug	nymph*	bug*	adult	one	Excess thatch, non-irrigated turf, fine fescues.
Sod webworms, lawn moths	caterpillar*	moth	larva	2-3	
Cutworms	caterpillar*	moth	eggs	2	Aeration, moisture, closely mowed turf.
Turfgrass scale	nymphs	adult scale	mature nymphs	one	Occurs on Kentucky bluegrass, red fescue, creeping bentgrass, sodded lawns of 3-5 years old.

**damaging stage*

DISEASE CONTROL

Disease	Control	Rate per 100 m^2	Remarks **Use sufficient water for thorough coverage. Follow label directions.**
Anthracnose *(Colletotrichum graminicola)*	Daconil 2787 F	170-190 mL	Occurs June to September. Avoid nitrogen deficiency and drought stress, especially on annual bluegrass.
Brown patch, Rhizoctonia blight *(Rhizoctonia solani)*	Daconil 2787 F Rovral 50 WP Rovral Green *Tersan 1991 WP 50 Dyrene 50 WP *Easout 70 WP Scotts Fertilizer + *DSB Thiram 80 WP Spotrete-F + PMAS PMAS Scotts Broad Spectrum Fungicide	95-190 mL 60-125 g 120-240 mL 60 g 125-250 g 30-60 g 865 g 90 g 175 mL + 40 mL 60 mL 1.29 kg	Brown patch occurs June to September. Cool weather brown patch occurs during the periods of April to May and September to November. Apply preventive control at 1-2 week intervals during periods when conditions favour disease development. Avoid excess nitrogen and night watering. Use higher rate and shorter interval under severe pressure.

**Systemic, apply at intervals of 3-4 weeks. Alternate with one of the other products listed.*

Disease	Control	Rate per 100 m²	Remarks Use sufficient water for thorough coverage. Follow label directions.
Dollar spot	Daconil 2787 F Rovral 50 WP Rovral Green *Tersan 1991 WP 50 Dyrene 50 WP *Easout 70 WP Scotts Fertilizer + *DSB Thiram 80 WP Scotts Broad Spectrum Fungicide Spotrete-F + PMAS Caddy PMAS, Clean Crop PMA-10	95-190 mL 45 g 60 mL 30 g 125-250 G 25-30 g 865 g 90 g 1.29 kg 175 mL + 40 mL 30 mL 60 mL	Occurs June to October. Avoid nitrogen deficiency, drought stress and night watering. Remove dew. Light frequent application of foliar-applied nitrogen will decrease the severity of dollar spot.
Fairy ring	Chemical control is not practical. Symptoms may be masked by maintaining moderate fertility levels, thorough watering and repeated deep cultivation of the affected area.		
Fusarium patch and Pink snow mold *(Microdochium nivale)*	Scotts FF II Plant-Prod 0-0-6 with 15.4% Quintozene *Arrest 75 W Daconil 2787 F *Tersan 1991 WP 50 Rovral Green Rovral WP *Easout 70 WP Scotts Fertilizer + *DSB Scotts Broad Spectrum Fungicide Caloclor WP PMAS, Clean Crop PMA-10	1.55 kg 1.5 kg 250 g 250-500 mL 125 G 360 mL 180 g 125-175 g 865 g 1.29 kg 90 g 60 mL	Fusarium patch occurs during cool, wet weather. Use ½ to ⅔ rate at first sign of disease in fall. Avoid succulent turf growth in late fall. For control of pink snow mold apply late in fall before permanent snow cover.
Grey snow mold, Typhula blight *(Typhula spp.)*	Scotts FF II Plant-Prod 0-0-6 with 15.4% Quintozene *Arrest 75 W Daconil 2787 F Rovral WP Rovral Green Terraneb SP Scotts Fungicide II Caloclor WP Scotts Broad Spectrum Fungicide Spotrete F + PMAS PMAS, Clean Crop PMA-10	1.55 kg 1.5 kg 250 g 250-500 mL 180 g 360 mL 175-275 g 1.45 kg 90 g 1.29 kg 375 mL + 75 mL 60 mL	Control with a single application late in fall before permanent snow cover. (Early to late November in southern Ontario, mid- to late October in northern Ontario). Avoid succulent turf growth in late fall. Keep turf mowed until leaf growth ceases. Use snow fencing or other methods to prevent excessive snow accumulation. Minimize thatch as this is a perfect environment for dormant sclerotia.
Helminthosporium leaf spot/ Melting Out *(Dreschslera spp.)*	Daconil 2787 F Dyrene 50 WP Rovral 50 WP Rovral Green Thiram 80 WP Scotts Broad Spectrum Fungicide	95-190 mL 125 g 60 g 120 mL 125 g 1.29 kg	Occurs April to June. For preventive control, spray 2 or 3 times one to two weeks apart, beginning when first spots appear in early spring. Avoid applications of early spring nitrogen as lush growth and cool wet conditions will result in increased disease susceptibility. If disease occurs remove clippings and increase mowing height to reduce disease severity.

Systemic, apply at intervals of 3-4 weeks. Alternate with one of the other products listed.

Disease	Control	Rate per 100 m²	Remarks Use sufficient water for thorough coverage. Follow label directions.
Low Temperature Basidiomycetes	Arrest 75 W	250-375 g	
Powdery mildew *(Erysiphe graminis)*	*Easout 70 WP	125-250 g	Avoid excess nitrogen and shade. Spray when symptoms appear. Repeat in 2 weeks if necessary.
Pythium blight, Cottony blight, Greasy spot *(Pythium aphanidermatum)*	Terraneb SP Scotts Fungicide II	125 g 1.45-2.9 kg	Avoid excess nitrogen and watering. Preventive control during periods of high temperature and high humidity. Repeat in 5-7 days if conditions remain favorable for disease.
Moss	Safer's De-Moss	32 mL/litre water	Moss problems are commonly associated with low fertility, poor drainage, soil compaction, heavy shade, poor air circulation and poorly adapted grasses.
Necrotic ring spot *(Leptosphaeria korrae)*	Symptoms occur September to October. No chemical control available. Reduce excess thatch. Attacks Kentucky bluegrass and fine fescues. Turf-type perennial ryegrasses and some Kentucky bluegrass varieties are resistant. Provide balanced fertility. Avoid drought stress.		
Red thread *(Laetisaria fuciformis)*	Occurs October to November. Avoid nitrogen deficiency, especially on perennial ryegrass and fescues.		
Rust *(Puccinia spp.)*	Use resistant varieties of Kentucky bluegrass, and perennial ryegrass. No chemical control available. Provide adequate levels of fertility. Mow frequently.		
Slime Molds	No chemical control. Remove spore masses by raking or hosing off the turf.		
Summer patch *(Magnaporthe poae)*	Symptoms occur July to August. Attacks annual bluegrass and Kentucky bluegrass. Avoid nitrogen deficiency. Apply light frequent watering during dry periods to reduce heat stress.		
Take-all patch *(Gaeumannomyces graminis)*	No chemical control available. Attacks bentgrasses. Symptoms occur April to June and September to November. Use acidifying (ammonium) fertilizers to reduce thatch pH. Avoid drought stress.		

**Systemic, apply at intervals of 3-4 weeks. Alternate with one of the other products listed.*

ABBREVIATIONS

EC = emulsifiable concentrate
SC = spray concentrate
AP = agricultural powder
WP = wettable powder
SP = soluble powder
W = wettable (powder)
F = flowable
G = granules
DP = dispersable powder
DU = dust
°C = degrees Celsius
% = percent (by weight)

gram = g
kilogram = kg
tonne = t
metre = m
kilometre = km
centimetre = cm
millimetre = mm
hectare = ha
litre = L
millilitre = mL
hectolitre = hL

WEED CONTROL FOR TURFGRASS (LAWNS, PARKS AND GOLF COURSES)

The major species of broadleaf weeds infesting lawns in Ontario are dandelion, plantain, black medick, chickweed, prostrate knotweed, mallow, henbit, ground-ivy, and white clover. The major grassy weeds are crabgrass, annual bluegrass, quackgrass, orchard grass and bentgrass.

One of the primary ways that a weed-free lawn can be maintained easily, cheaply, and with a minimum of effort, is through an effective lawn maintenance strategy which takes advantage of the vigorous growth of a turfgrass, and therefore is the key to keeping lawn areas free of weeds. Most weeds cannot compete with a dense, healthy turf, so the maintenance of such a stand is of primary importance in producing a weed-free area. Practices that tend to encourage vigorous grass growth will discourage weed infestations. Such practices include proper irrigation and/or drainage, use of fertilizers, insect and disease control, and the use of the correct type of turfgrass for the situation.

Mowing is beneficial because it stimulates bud development and tillering, inducing the sod to become thick and dense. Commonly grown grasses such as the fescues, bluegrasses, and turf-type perennial ryegrasses should be cut at a height of 4 to 6 cm. If grasses are cut shorter than this, invasion by weeds may occur. Avoid scalping the turf when cutting around trees and flower beds and do not remove more than one-third of the leaf area when mowing. Mowing too frequently may reduce the carbohydrate reserves of the turf, thereby reducing its competitiveness. Mowing can also be used to remove annual weeds and climinate seed production thereby reducing or preventing the spread of weeds.

Fertilizer is particularly important in establishing a thick, dense, and healthy turf sward. Too few nutrients applied to the sod will lead to increased susceptibility to disease and insects and the root system of the turf will not develop, leading to an inability of the grass to withstand traffic and recover from injury. Too much fertilizer may lead to soft, weak grass that is prone to disease damage.

Watering is particularly important during periods of drought that may injure, kill or induce dormancy in the turf, thereby allowing weeds to become established. Irrigation should be carried out at weekly intervals with about 3 cm of water per application to help produce deep-rooted turf. Frequent light sprinkling will have the opposite effect on the grass roots. Light water applications encourage the germination and growth of shallow rooted species such as crabgrass and creeping bentgrass. Too much irrigation water will lead to infestations by yellow nutsedge and annual bluegrass. Therefore, it is important to install adequate drainage to ensure that waterlogging does not occur. Remember to provide adequate watering near trees and hedges because they compete for available moisture.

Compaction brought about by excessive traffic will often result in invasion by knotweed and annual bluegrass. Aeration practices will help in these situations but the best answer is to modify the area to reduce heavy traffic. Immediate resodding or reseeding of damaged areas will help to discourage weed infestations.

Use of the best turfgrass species for a given situation is very important. For example, fescues are tolerant to low light intensity in shaded areas under trees, whereas turf-type perennial ryegrass varieties are quick to establish in newly seeded areas and will crowd out germinating weeds. Kentucky bluegrass, although slow to establish, is very competitive once established.

Provided weed populations are not too high, weeds can be removed by hand pulling or with a knife or V-shaped spudding tool. The reader is referred to other publications on these subjects from Agriculture Canada and the Ontario Ministry of Agriculture and Food (see address located near the end of this publication).

Chemical weed control is often the easiest, most effective and cheapest way to control annual and perennial weeds when populations are very high. The 2,4-D spray is most effective in the spring, or in September when the weeds are growing well. The treatment will generally thin Dutch clover in the lawn. Mecoprop, dichlorprop, and dicamba will control a number of weeds resistant to 2,4-D. As with 2,4-D, a thorough wetting of the weed foliage is emphasized. Mecoprop, dichlorprop and dicamba are also sold in mixtures with 2,4-D. Mecoprop is safer to use on bentgrass than 2,4-D.

Mixtures containing dicamba should not be used close to shrubs, etc., at rates above 425 g (active) per hectare. Prepared mixtures of this chemical and 2,4-D are effective on a wide range of lawn weed species, including knotweed which is resistant to most other herbicides except when very young. After seeding new turf, many annual weeds may emerge before the grass seedlings are up. If these young weeds are not controlled they will shade, and eventually crowd out much of the grass population. Mowing at a height of 6 to 8 cm will eliminate many such weeds. If they are extremely thick, 2,4-D at one-half the usual concentration (1.1 kg in 800 L water/ha) or mecoprop (1.1 kg in 400 L water/ha) can be used—but not before the grass has been up at least 4 weeks.

WEEDS	Generic Name TRADE NAME & Formulation ( )	Rate (Active) RATE	REMARKS
Many broadleaf weeds including dandelion, lamb's-quarters, mustards, peppergrass, pigweeds, plantains, shepherd's purse, smartweeds, vetch. More resistant weeds include chick-weeds, clovers, black medick and knotweed	2,4-D amine (500 g/L)	0.8 to 1.4 kg/ha 1.6 to 2.8 L/ha in 200 to 400 L water/ha	Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. Do not irrigate, rake, and/or mow until at least 24 hours after application. Do not apply to newly seeded lawns until after second mowing. Do not apply to bentgrass unless necessary, and then only at 0.28 kg/ha. Some yellowing of bentgrass may occur.
Will control most broadleaf weeds including 2,4-D tolerant weeds such as chick-weeds, clover, and knotweed when young. Will not adequately control plantain in most situations	dicamba BANVEL (480 g/L)	0.6 kg/ha 1.25 L/ha in 200 to 400 L water/ha	Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. Do not irrigate, rake, and/or mow until at least 24 hours after application. Do not apply to newly seeded lawns until after second mowing. Do not apply to bentgrass at 0.6 kg/ha but may be applied at lower doses when mixed with phenoxy herbicides. Do not apply near shallow-rooted perennials because dicamba can be taken up by the roots of these plants. Pure dicamba is recommended for use in certain situations only; it is best when mixed at low use rates with phenoxy herbicides.
Dandelion, field horsetail, lamb's-quarters, mustards, plantains, shepherd's purse, wild carrot. More resistant weeds include chickweeds, clovers and black medick	MCPA amines (500 g/L)	1.1 to 1.4 kg/ha 2.2 to 2.8 L/ha in 200 to 400 L water/ha	Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. Do not irrigate, rake, and/or mow until at least 24 hours after application. Do not apply to newly seeded lawns until after second mowing. Do not apply to bentgrass unless necessary, and then only at 0.28 kg/ha. Some yellowing of bentgrass may occur. MCPA can be used as a substitute for 2,4-D. At slightly higher doses than 2,4-D it will usually provide as good weed control as 2,4-D. Control of dandelion and plantain may not be as good as with 2,4-D during dry, hot weather.
Spectrum of weed control is not as broad as with 2,4-D, dicamba, or MCPA. However, many 2,4-D and MCPA tolerant weeds such as chickweeds, clovers, ground ivy and black medick can be con-trolled with mecoprop	mecoprop COMPITOX (150 g/L)	0.8 to 1.3 kg/ha 5.5 to 8.5 L/ha in 200 to 400 L water/ha or 60 to 90 mL in 5 to 10 L water/100m^2	Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. Do not irrigate, rake, and/or mow until at least 24 hours after application. Do not apply to newly seeded lawns until after second mowing. May be applied to bentgrass. Apply before flower to dandelion. Repeated applications may be required for complete control of dandelion and black medick.
Will control most broadleaf weeds, including 2,4-D tolerant weeds such as chickweeds, clovers, creeping charlie, black medick, and knot-weed when young	dicamba (480 g/L) + 2,4-D (500 g/L)	0.6 kg/ha 1.25 L/ha + 0.55 to 1.1 kg/ha 1.1 to 2.2 L/ha in 200 to 400 L water/ha	Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. Do not irrigate, rake, and/or mow until at least 24 hours after application. Do not apply to newly seeded lawns until after second mowing. Do not apply to bentgrass. Provides broader spectrum weed control than 2,4-D or dicamba applied alone (see precautions under dicamba).

WEEDS	Generic Name TRADE NAME & Formulation ( )	Rate (Active) RATE	REMARKS
	dicamba/2,4-D DYCLEER 24 (600 g/L)	1.65 kg/ha 2.75 L/ha in 200 to 400 L water/ha	
Will control most weeds, including 2,4-D tolerant weeds such as chickweeds, clovers, creeping charlie and black medick	2,4-D (500 g/L) + mecoprop (150 g/L)	0.85 to 1.1 kg/ha 1.7 to 2.2 + 0.85 to 1.1 kg/ha 5.7 to 7.3 L/ha	Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. Do not irrigate, rake, and/or mow until at least 24 hours after application. Do not apply to newly seeded lawns until after second mowing. Do not apply to bentgrass. Provides broader spectrum weed control than 2,4-D or mecoprop applied alone. May be combined with dicamba (100 g ai/ha; 208 mL product) for the control of young knotweed.
	2,4-D/mecoprop MECOTURF PLUS 2,4-D (400 g/L)	1.7 to 2.2 kg/ha 4.25 to 5.5 L/ha in 200 to 400 L water/ha or 40 to 50 mL in 3 to 8 L water/100 m^2	
Will control most broadleaf weeds including 2,4-D tolerant weeds such as chickweeds, clovers, black medick, ground ivy, and knotweed when young	2,4-D/dicamba/ mecoprop KILLEX (308 g/L)	1.7 kg/ha 5.5 L/ha in 200 to 400 L water/ha or 60 mL in 5 to 10 L water/100 m^2	Avoid contact with ornamentals and flowers. Avoid applying during hot, dry weather. Do not irrigate, rake, and/or mow until at least 24 hours after application. Do not apply to newly seeded lawns until after second mowing. In closely mowed bentgrass (greens) it can be used only at half doses (30 mL/100 m^2). Temporary yellowing of bentgrass may occur. Recovery from injury will occur one week after application (see precautions under dicamba).
Crabgrass	bensulide BETASAN (480 g/L)* BETASAN (12.5 G)	11 to 16.5 kg/ha 23.1 L to 34.6 L/ha 88 to 132 kg/ha	Apply before crabgrass emergence in early spring, or in fall to established turf. Use the higher rate for fall application only if no re-seeding has been done in the fall.
	chlorthal dimethyl DACTHAL (75 WP) DACTHAL (2.3 G)**	11.6 to 20.3 kg/ha 15.5 to 27 kg/ha 504 to 882 kg/ha	
	siduron TUPERSAN	9 to 13.5 kg/ha (available as fertilizer mix only)	Crabgrass may be controlled in a newly seeded area by applying siduron (TUPERSAN) at 6.75 kg (active) per hectare. This chemical must be applied after seeding but before emergence of the crabgrass seedlings. Apply only in early spring. Follow manufacturer's directions especially when applying to certain bentgrass strains.

WEEDS	Generic Name TRADE NAME & Formulation ( )	Rate (Active) RATE	REMARKS (For more information, see "Notes on Chemicals" section.)
Crabgrass, foxtail species, Witch grass, Barnyard grass	fenoxaprop ethyl ACCLAIM (90g/L)	0.198 L/ha 2.2 L/ha	Apply as postemergent application at 1 leaf to 4 leaf plus 3 tiller and Multi-tillered to heading. A second application may be required on mature monostands 21 days after first application. Do not apply to bentgrass or seedling Kentucky bluegrass. Do not tank mix with any other herbicide or pesticide. Do not spray a broadleaf herbicide 7 days prior to or 7 days after an application of Acclaim. Do not spray during periods of drought stress as poor control and possibly damage to desirable turf species may occur.
Annual bluegrass (Poa annua)	bensulide BETASAN (480 g/L) BETASAN (12.5 G)	13.5 to 16.5 kg/ha 28.4 to 34.6 L/ha 108 to 132 kg/ha	Repeated treatments will be required. Reseeding the area will not be possible for one year following treatment.
	chlorthal-dimethyl DACTHAL (75 WP) DACTHAL (2.3 G)*	11.6 to 20.3 kg/ha 15.5 to 27.0 kg/ha 504 to 833 kg/ha	
Emerged yellow nutsedge	bentazon BASAGRAN (480 g/L) plus oil concentrate ASSIST	0.84 kg/ha 1.75 L/ha 2 L/ha	Top growth of nutsedge is controlled by 2 applications 10 days apart.

**DACTHAL 5.0 G use 232 to 406 kg/ha.*

NOTE: To convert kg or L/ha to g or mL/100 m^2 multiply by 10 (example: 11 kg/ha becomes 110 g/100 m^2 and 28.4 L/ha becomes 284 mL/100 m^2).

TURFGRASS RENOVATION

The turf to be renovated should be mowed and thoroughly raked to remove all dead and cut vegetation. Apply paraquat (GRAMOXONE) at a rate of 2.0 kg (active) or 10 L (product) in 1,000 L water per hectare. This treatment will "burn off" all emerged vegetation. When the old turf is dead, rotovate top 5 cm to cover dead grass, rake the surface to prepare seedbed and reseed.

Apply glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 4.75 to 7.0 L/ha (product) in 200 to 300 L water per hectare after omitting at least one regular mowing. Tillage should be delayed 7 days after application to allow for proper translocation into underground plant parts. Direct seeding into the killed turf (no tillage) may be carried out.

TURFGRASS RETARDATION

Reduction in grass growth may be brought about by treatment with maleic hydrazide (ROYAL MH 60 SG, 6.5 to 8.0 kg/ha product). Manufacturer's directions should be followed carefully. This chemical is recommended for use in areas where mowing and trimming are difficult and where a lawn-like appearance is not necessary.

TURFGRASS ESTABLISHMENT

When it is desired to establish turfgrass in areas that are heavily infested with weeds such as quackgrass, the area should be treated with glyphosate (ROUNDUP) prior to the preparation of the seedbed.

Use glyphosate (ROUNDUP) at 1.7 to 2.5 kg (active) or 4.75 to 7.0 L/ha (product) in 200 to 300 L water per hectare applied postemergence when quackgrass is actively growing and has at least four leaves. Allow 7 or more days after application before tillage. For maximum quackgrass control, a repeat treatment may be necessary before grass establishment. If retreatment is necessary, wait until quackgrass has reached the 3- to 4-leaf stage.

For other perennial weeds follow label instructions for proper rate and stage of growth.

TABLE 13: CLASSIFICATION OF WEEDS ACCORDING TO RESPONSE TO VARIOUS FOLIAGE SPRAYS

Common Name	2,4-D	MCPA	2,4-DB or MCPB	Mecoprop	Dicamba
aster (P)	I				
bedstraw (P)	R	I-R	R	I	R
bellflower (P)	R				
bindweed, field (P)	I	I	I	I	S-I
blueweed (B)	S-I	I		I	I
bracken fern (P)	R	R	R	R	I
buckwheat, wild (A)	I-R	I	I-R	I-R	S
burdock (B)	S	S	I		S
buttercup (P)	I-R	S-I	I**(I-R)	I	I
campion, bladder (P)	R	R	R	R	
carrot, wild (B)	S-R	S-R	R	I-R	S
catchfly, night-flowering (A)	R	R	R	R	
catnip (P)	S-I				
chickweed, common (A)	I-R	I	R	S	S
chickweed, mouse-eared (P)	I-R	I-R	R	S	S
chicory (P)	S	S-I	S-I*(R)	I-R	S
cinquefoil, rough (WA)	I				
cinquefoil, sulfur (upright c.), (P)	I				
cocklebur (A)	S	S	S	S	S
cockle, purple (A)	I-R	R	R		I
cockle, white (P)	R		I-R		I
daisy, ox-eye (P)	I	I	R	I	I
dandelion (P)	S	S	I*(R)	I	S
dock (P)	I	I	I	I	
evening-primrose (B)	S				
false flax (WA)	S	S	S	S	S
fleabane, annual (daily f.) (WA)	I	I	S-I		
fleabane, Canada (A)	S-I				
goat's-beard (B)	I				
goldenrod (P)	I	R	I	I	
goosefoot (A)	S	S	S	S	
goutweed (P)	R	R	R	R	
grasses (A and P)	R	R	R	R	
ground-ivy (creeping charlie) (P)	I-R	I-R		I	S
groundsel (A)	I	I			
hawkweed (P)	I-R	I-R			S-I
heal-all (P)	I-R	I-R	I-R	S	S
hemp-nettle (A)	R	S-I	I-R**(R)	R	
horse-nettle (P)	R				I
horsetail (P)	I-R	S-I	I-R	I-R	I
knapweeds (P)	R				I
knotweed (A)	I-R		I*(I-R)	S-I	S
Lady's-thumb (A)	S-I	I-R	I-R*(R)	I-R	S
lamb's-quarters (A)	S	S	S	S	S
lettuce, prickly (A)	S-I	S	S	S	
mallow, round-leaved (P)	I-R	I-R	I-R	I-R	
mayweed (A)	I-R		R		S
medick, black (WA)	I	I	I	S	I
milkweed (P)	R	R	R	I-R	I-R
motherwort (P)	S-I				

Kentucky Bluegrass
Poa pratensis
Kentucky bluegrasses are used extensively for turf areas such as home lawns, sports fields, parks and sod farms. This species produces a high quality, dark green, dense turf with low growth habit of medium to fine texture. Most varieties of Kentucky bluegrasses have good cold tolerance, good recuperative potential from turf injury, good tolerance to traffic and resistance to diseases such as leaf spot.

Kentucky bluegrasses will adapt to a wide range of soil and management conditions but prefer moderate fertility, well drained soil and full sun.

Although not very drought resistant, Kentucky bluegrasses can survive long, dry periods in a dormant state.

Varieties available include: A34, Abbey, Adelphi, Alene, Alpine, Amazon, America, Ampellia, Argyle, Banff, Baron, Bristol, Bronco, Challenger, Chateau, Cheri, Classic, Coventry, Cynthia, Columbia, Dormie, Eclipse, Enmundi, Entopper, Estate, Fylking, Georgetown, Geronimo, Glade, Gnome, Haga, Harmony, Ikone, Julia, Liberty, Majestic, Merion, Midnight, Minstrel, Monopoly, Mystic, Newport, Nugget, Parade, Park, Prato, Princeton, Ram I, Regent, Rugby, S-21, Scenic, Sophia, Suffolk, Sydsport, Touchdown, Trampas, Troy, Victa, Wabash, Welcome.

Canada Bluegrass
Poa canadensis
Varieties available include: Canon, Reubens.

Rough Bluegrass
Poa trivialis
Varieties available include: Colt, Laser, Sabre.

Fine Fescue
(Creeping Red Fescue, Chewings Fescue, Hard Fescue)
Festuca spp.
Fine fescues produce a fine-textured turf that is medium green in color, and of low growth habit. These species grow well under low moisture and low maintenance conditions. Most varieties perform well in moderate shade.

Varieties available include:

Creeping Red Fescues: Bargena, Cindy, Dawson, Durlawn, Ensylva, Flyer, Fortress, Franklin, Jasper, Merlin, Medallion, Pennlawn, Recent, Reptans

Chewings Fescues: Agram, Banner, Barfalla, Center, Enjoy, Epsom, Highlight, Jamestown, Koket, Longfellow, Luster, Mary, Menuet, Shadow, Victory, Waldorf, Wilma.

Hard fescues: Aurora, Biljart, Crystal, Reliant, Scaldis, Serra, Silvana, Spartan, SR3000, Tournament

Sheep Fescues: Nakiska

Turf-Type Perennial Ryegrass
Lolium perenne
This species is well adapted to southern Ontario conditions. It produces a medium-textured turf. It can be used in mixtures with Kentucky bluegrass and is an excellent species to use for turf renovation, due to its quick rate of establishment.

Varieties* containing endophytic fungi have exhibited increased resistance to many common turf insects including bluegrass bill bug, sod webworms, and chinch bugs, therefore offering an alternative to chemical insect control. Endophyte-enhanced varieties may also exhibit increased tolerance of stress conditions.

Varieties available include: All-Star*, Barry, Barclay, Birdie II*, Blazer*, Blazer II, Brenda, Caliente, Charger, Citation II*, Competitor, Crown, Dasher II*, Derby*, Dimension, Diplomat, Elka, Fiesta*, Fiesta II*, Gator*, Jazz*, Loretta, Low Grow, Manhattan II*, Mondial, Omega II*, Palmer*, Pennant, Pennfine*, Pinnacle, Pippin, Player, Prelude*, Premier*, Ranger*, Repell*, Riviera, Saturn, Seville, SR4000*, SR4100*, Surprise, Trimmer, Yorktown II*, 246.

Creeping Bentgrass
Agrostis palustris
This species is used almost exclusively on golf courses due to the high level of maintenance required.

Varieties available include: Biska, Cobra, Emerald, National, Penncross, Penneagle, PennLinks, Prominent, Providence, Seaside, SR1020.

Tall Fescue
Festuca arundinacea
This is a medium-to-coarse-textured turf species that is tolerant of heat, drought, shade and salt. It is suitable for a wide range of soils and requires low to moderate fertility.

It is currently being evaluated in Ontario for use on sports fields and along highways and boulevards.

Varieties available include: Adventure, Apache, Arid, Bonanza, Bonsai, Crossfire, Emperor, Falcon, Finelawn I, Jaguar, Jaguar II, Mustang, Rebel, Rebel II, Tempo, Tribute, Willamette, Winchester, Shenandoah, Shortstop.

TABLE 14: TURFGRASS SELECTION

Use	Species
Lawns (Sun)	
Moderate to high maintenance	Kentucky bluegrass, turf-type perennial ryegrass
Low maintenance, dry	fine fescues
Lawns (Shade)	
Dry	fine fescue blend or suitable mixture with perennial ryegrasses and shade-tolerant Kentucky bluegrasses
Wet	Rough bluegrass
Athletic Fields	
New fields	Kentucky bluegrass blends or Kentucky bluegrass/perennial ryegrass mixture
Overseeding	Turf-type perennial ryegrasses
Golf courses	
Greens	Creeping bentgrass, fine fescues (at establishment)
Tees	Creeping bentgrass, Kentucky bluegrass, turf-type perennial ryegrass
Fairways	Creeping bentgrass, Kentucky bluegrass, fine fescues

TABLE 15: TURF ESTABLISHMENT

Seeding Species	Seeding Rate per 100 m^2
creeping bentgrass	.5-1.0 kg
Kentucky bluegrass	1.0-2.0 kg
perennial ryegrass	2.0-4.0 kg
fine fescue	1.0-3.0 kg
tall fescue	2.0-3.0 kg

Time of Seeding

Seeding can be done mid-April to early June, mid-July to end of September, or as a dormant seeding. The period from mid-August to mid-September is the preferred seeding time as soil moisture and temperature conditions are optimum for germination and there is less competition from germinating weeds.

Weed Control

Broadleaf weeds can be a problem in newly seeded turf. Weeds such as mustard, ragweed, lamb's-quarters can be controlled by mowing. Chemical control can be applied once seedlings have been mowed several times.

Mowing Newly Seeded Turf

For Kentucky bluegrasses, fine fescues, perennial ryegrasses and tall fescues, allow approximately 4 cm growth before first mowing. Maintain at mowing heights as listed in Table 17. For bentgrasses mow after 2.5 cm growth. For the next 2-3 mowings cut at 12.5 mm, gradually reducing it to the desired mowing height.

TABLE 16: ONTARIO DISTRIBUTORS OF TURFGRASS VARIETIES LISTED IN PUBLICATION 384

Albion Seed P.O. Box 1492, Bolton, Ontario L0P 1A0	(416) 880-4784
Bishop Farm Seeds Ltd. Box 338, Belleville, Ontario K8N 5A5	(613) 968-5533
Oseco Inc. P.O. Box 219, Brampton, Ontario L6V 2L2	(416) 846-5080
Ontario Seed Company Box 144, Waterloo, Ontario N2J 3Z9	(519) 886-0557
Heritage Seeds 75 Cardigan St., Guelph, Ontario N1H 3Z7	(519) 822-4800
Pickseed Box 126, Richmond Hill, Ontario L4C 4X9	(416) 846-5080
Parsons Seeds Ltd. P.O. Box 280, Beeton, Ontario L0G 1A0	(416) 729-2202
Rothwell Seeds Ltd. Box 511, Lindsay, Ontario K9V 4L9	(705) 324-9591
The Scotts Company 39 Monte Vista Trail Brampton, Ontario, L6Z 1Y2	(416) 846-3319 (416) 839-6526
F.R. Smith Seeds Ltd. 25 Bertal Road, Toronto, Ontario	(416) 762-0422
Speare Seeds Ltd. P.O. Box 171, Harriston, Ontario N0G 1Z0	(519) 338-3840

For more information on turfgrass varieties registered in Canada contact Agriculture Canada, Plant Health Directorate, Seed Division Ottawa, Ontario K1A 0C6.

TABLE 17: RECOMMENDED MOWING HEIGHTS

	Mowing Height	Clippings*
Greens	4.8-7.5 mm	remove
Tees	7.6-15 mm	remove
Fairways	1.3-2.3 mm	return or remove
Athletic Fields	2.5-5 cm	return
Lawns	4-6 cm	return

**Clippings contain nutrients that can be utilized by the soil. If they are removed, additional nutrients, in particular nitrogen and potassium, will have to be increased. If turf is mowed regulary, clippings do not contribute to thatch accumulation.*

PUBLICATIONS

Publications and Factsheets are available free of charge (unless otherwise stated) from the Ontario Ministry of Agriculture and Food, Consumer Information Centre, 801 Bay St., Toronto, Ontario M7A 2B2 or from your local County Agricultural Office; or from the extension horticulturist serving your area.

Pub. No.	OMAF PUBLICATIONS
29	*Drainage Guide for Ontario*
64	*Insect and Disease Control in the Home Garden*
75	*Guide to Weed Control*
82	*Nectar Trees, Shrubs and Herbs in Ontario*
162	*Turfgrass Diseases and Insect Pests ($3.00 per copy)*
204	*Pasture Grasses identified*
501	*Farm Drainage*
505	*Ontario Weeds ($5.00 per copy)*
529	*Weed Control in Lawns and Gardens*

Agdex #	OMAF FACTSHEETS
273	*Lawn Bowling and Putting Greens*
273	*Lawn Maintenance*
273	*Lawn Renovation*
273	*Fall Fertilization of Turf*
273	*Controlling Native Creeping Bentgrass in Lawns*
273/626	*Grubs in Lawns*
273/626	*Hairy Chinch Bugs in Lawns*
607	*Guide to Handling and Applying Herbicide to Protect Water Supplies and Reduce Personal Injury*
607	*Management of Pesticides on the Farm*
607	*Pesticide Container Rinsing*
607	*Pesticide Contamination of Farm Water Supplies*
607	*Reducing Pesticide Drift and Crop Damage*
607	*Storing Pesticides on the Farm*
744	*Field Sprayer Calibration*
273/646	*Annual Bluegrass*
273/23	*Thatch — Causes & Control*

When ordering publications please refer to the Agdex number and title.
A complete list of Factsheets and Publications is available from the address indicated.

AGRICULTURE CANADA PUBLICATIONS

(Available from Communications Branch and Publications Distribution, Agriculture Canada, Ottawa K1A 0C7)

1516	*Gypsy Moth*
1718	*Major Pests of Birch and Maple Trees*

ONTARIO MINISTRY OF THE ENVIRONMENT

(Available from Ministry of Environment Field Offices)

Personal Protective Equipment for Pesticide Users
Pesticides Safety Handbook
Pesticides Act and Regulations
Chemical Storage Signs
Index of Agent Codes
Guidelines for Storage, Disposal and Transportation of Pesticides
Fires and Stored Pesticides
Pesticide Spills

METRIC INFORMATION

THE METRIC SYSTEM

Linear Measures (length)
10 millimetres (mm) = 1 centimetre (cm)
100 centimetres (cm) = 1 metre (m)
1000 metres = 1 kilometre (km)

Square Measures (area)
100 m x 100 m = 10,000 m^2 = 1 hectare (ha)
100 ha = 1 square kilometre (km^2)

Cubic Measures (volume)
Dry Measure
1000 cubic millimetres (mm^3) = 1 cubic centimetre (cm^3)
1,000,000 cm^3 = 1 cubic metre (m^3)
Liquid Measure
1000 millilitres (mL) = 1 litre (L)
100 L = 1 hectolitre (hL)

Weight — Volume Equivalents (for water)
(1.00 kg) 1000 grams = 1 litre (1.00 L)
(0.50 kg) 500 g = 500 mL (0.50 L)
(0.10 kg) 100 g = 100 mL (0.10 L)
(0.01 kg) 10 g = 10 mL (0.01 L)
(0.001 kg) 1 g = 1 mL (0.001 L)

Weight Measures
1000 milligrams (mg) = 1 gram (g)
1000 g = 1 kilogram (kg)
1000 kg = 1 tonne (t)
1 mg/kg = 1 part per million (ppm)

Dry — Liquid Equivalents
1 cm^3 = mL
1 m^3 = 1000 L

CONVERSION TABLES – IMPERIAL TO METRIC

Length		
inch	=	2.54 cm
foot	=	0.30 m
yard	=	0.91 m
mile	=	1.61 km
Area		
square foot	=	0.09 m^2
square yard	=	0.84 m^2
acre	=	0.40 ha
Weight		
ounce	=	28.35 g
pound	=	453.6 g
ton	=	0.91 tonne
Volume (dry)		
cubic yard	=	0.76 m^3
bushel	=	36.37 L
Volume (liquid)		
fluid ounce (Imp.)	=	28.41 mL
pint (Imp.)	=	0.57 L
gallon (Imp.)	=	4.55 L
gallon (U.S.)	=	3.79 L
Temperature		
°F	=	(°C x 9/5) + 32
Pressure		
pound per square inch	=	6.90 kPa

CONVERSION TABLES – METRIC TO IMPERIAL

Length

1 millimetre (mm)	=	0.04 inch
1 centimetre (cm)	=	0.40 inch
1 metre (m)	=	39.40 inches
1 metre (m)	=	3.28 feet
1 metre (m)	=	1.09 yards
1 kilometre (km)	=	0.62 mile

Volume (liquid)

1 millilitre (mL)	=	0.035 fluid ounce
1 litre (L)	=	1.76 pints
1 litre (L)	=	0.88 quart
1 litre (L)	=	0.22 gallon (Imperial)
1 litre (L)	=	0.26 gallon (U.S.)

Weight

1 gram (g)	=	0.035 ounce
1 kilogram (kg)	=	2.21 pounds
1 tonne (t)	=	1.10 short tons
1 tonne (t)	=	2205 pounds

Pressure

1 kilopascal (kPa)	=	0.15 pounds/square inch

Area

1 square centimetre (cm^2)	=	0.16 square inch
1 square metre (m^2)	=	10.77 square feet
1 square metre (m^2)	=	1.20 square yards
1 square kilometre (km^2)	=	0.39 square mile
1 hectare (ha)	=	107.636 square feet
1 hectare (ha)	=	2.5 acres

Volume (dry)

1 cubic centimetre (cm^3)	=	0.061 cubic inch
1 cubic metre (m^3)	=	1.31 cubic yards
1 cubic metre (m^3)	=	35.31 cubic feet
1000 cubic metres (m^3)	=	0.81 acre-foot
1 hectolitre (hL)	=	2.8 bushels

Speed

1 metre per second	=	3.28 feet per second
1 metre per second	=	2.24 miles per hour
1 kilometre per hour	=	0.62 mile per hour

Temperature

$°C = (°F - 32) \times 5/9$

APPLICATION RATE CONVERSIONS
(approximate)

Metric to Imperial (Approximate)

litres per hectare x 0.09	=	gallons per acre
litres per hectare x 0.36	=	quarts per acre
litres per hectare x 0.71	=	pints per acre
millilitres per hectare x 0.015	=	fluid ounces per acre
grams per hectare x 0.015	=	ounces per acre
kilograms per hectare x 0.89	=	pounds per acre
tonnes per hectare x 0.45	=	tons per acre

Imperial to Metric (Approximate)

gallons per acre x 11.23	=	litres per hectare (L/ha)
quarts per acre x 2.8	=	litres per hectare (L/ha)
pints per acre x 1.4	=	litres per hectare (L/ha)
fluid ounces per acre x 70	=	millilitres per hectare (mL/ha)
tons per acre x 2.24	=	tonnes per hectare (t/ha)
pounds per acre x 1.12	=	kilograms per hectare (kg/ha)
ounces per acre x 70	=	grams per hectare (g/ha)

Liquid Equivalents

Litres/Hectare	=	Approximate Gallons/Acre
50	=	5
100	=	10
150	=	15
200	=	20
250	=	25
300	=	30

Dry Weight Equivalents

Grams or Kilograms per Hectare	=	Approximate Ounces or Pounds per Acre
100 grams	=	1½ ounces
200 grams	=	3 ounces
300 grams	=	4¼ ounces
500 grams	=	7 ounces
700 grams	=	10 ounces
1.10 kilograms	=	1 pound
1.50 kilograms	=	1¼ pounds
2.00 kilograms	=	1¾ pounds
2.50 kilograms	=	2¼ pounds
3.25 kilograms	=	3 pounds
4.00 kilograms	=	3½ pounds
5.00 kilograms	=	4½ pounds
6.00 kilograms	=	5¼ pounds
7.50 kilograms	=	6¾ pounds
9.00 kilograms	=	8 pounds
11.00 kilograms	=	10 pounds
13.00 kilograms	=	11½ pounds
15.00 kilograms	=	13½ pounds

SPRAYING RECORD

LOCATION	DATE	MATERIAL USED	RATE OR AMOUNT	WEATHER AND SOIL CONDITIONS

EMERGENCY AND FIRST-AID PROCEDURES FOR PESTICIDE POISONING

Become familiar with the chemicals you are using. Keep a list of common names in case of accidents or emergencies. This information can be found on the product labels and cross-referenced in this publication.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water. Repeat the wash.

If a pesticide has come in contact with the eyes, rinse them with plenty of clean water for 15 minutes.

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL. TAKE THE LIST OF CHEMICAL COMMON NAMES WITH YOU AND IDENTIFY THE ONES BEING USED.

IF A PERSON IS FOUND UNCONSCIOUS OR LAPSES INTO UNCONSCIOUSNESS, CALL AN AMBULANCE IMMEDIATELY.

EMERGENCY ADVICE ON PESTICIDE POISONING IS AVAILABLE BY CONTACTING THE POISON INFORMATION CENTRES: THE NAMES AND TELEPHONE NUMBERS ARE LISTED UNDER EMERGENCY CALLS AT THE FRONT OF EACH BELL TELEPHONE DIRECTORY.

Fill in the following:

MY LOCAL POISON INFORMATION CENTRE TELEPHONE NUMBER IS:

_____ _____

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